



Missouri Department of Agriculture Specialty Crop Block Grant Program USDA AMS Agreement 12-25-B-1078 Final Performance Report

Richard Fordyce, Director

Contacts

Program Contact: Susan Bennett, Grants Specialist
1616 Missouri Blvd.
Jefferson City, MO 65109
Phone; (573) 526-9548
Susan.Bennett@mda.mo.gov

Administrative Contact: Jane McIntosh, Grant Manager
:
1616 Missouri Blvd.
Jefferson City, MO 65109
Phone: (573) 522-1955
Jane.McIntosh@mda.mo.gov

USDA AMS Agreement Number; 12-25-B-1078
Final Performance Report

Date Submitted: December 20, 2013
Resubmitted: February 13, 2014

Table of Contents		Page
Project 1:	Scaling up Production of Specialty Crops for Winter Sales at the Columbia Farmers' Market	2
Project 2:	Introducing Flash Freezing Technology to Missouri Specialty Crop Growers	7
Project 3:	Studies on Shoot Density, Row Orientation and Canopy Management Practices on Growth, Yield, and Fruit Composition of Norton Grapes	14
Project 4:	River Hills Elderberry Producers Grower Support and Value-Added Education Project	24
Project 5:	Farm-to-College as a Catalyst for Specialty Crop Production	27
Project 6:	Vegetable Training and Education Garden	35
Project 7:	Advancement of American Elderberry as a Missouri Specialty Crop by Elucidating its Pest and Disease Complex	45
Project 8:	Disinfestation of Asian Chestnut Gall Wasp Larvae from Chestnut Scion Wood to Produce a Clean Source of Nursery Stock	48
Project 9:	City Greens Bonus Incentive Project	53
Project 10:	Enhancing Missouri Specialty Crop Opportunities through Training and Outreach	58
Project 11:	Increasing Child and Adult Nutrition Knowledge and Consumption of Specialty Crops in Southwest Missouri through Social Media and Consumption of Specialty Crops	62
Project 12:	City Seeds	68
Project 13:	High Tunnel Production of High Lycopene Tomatoes Using a Disease Resistant Rootstock	75

Project 1: Scaling up Production of Specialty Crops for Winter Sales at the Columbia Farmers' Market

Columbia Farmers' Market (CFM)

Corrina Smith, Market Manager
Final Performance Report

Project Summary

The purpose of this project was to provide an indoor winter market for vendors and enable them to expand their yearly income while offering a wide selection of local, fresh, healthy specialty crops to consumers. By surveying vendors, CFM discovered a majority had the desire to scale up their production of specialty crop items with the use of high tunnels, row covers, and greenhouses in order to continue the supply throughout the winter season. By expanding the market throughout the whole year rather than just the summer season, significantly more fresh local produce would be available to the community.

With the growing increase of farmers using high tunnels, row covers and greenhouses, more varieties of vegetables are becoming easier to grow during winter months. With this increase, vendors were seeking an outlet to be able to provide these products to the community. By creating an indoor market during the winter months, customers and vendors would have a safe, warm and dry place to sell and shop. CFM has been actively working to build a covered pavilion where the market could operate year-round. Since the Winter Market was so successful, the pavilion committee began to review and adjust the old plans to include the ability to enclose for year-round use.

Project Approach

CFM began implementing the Winter Market plan in 2010. As the original location was judged insufficient to support a growth in number of vendors, in 2011 the indoor market was moved to Parkade Plaza. The Parkade Plaza is the first "traditional mall" built in Columbia, MO in the 1970's. Since then, two new malls were subsequently built and the Parkade Plaza lost most of its retail vendors. Space became available and was leased for office use or small service providers. The bright and wide hallways are a perfect location for food vendors to set up tables and have plenty of room for customers to comfortably shop for healthy local food. Going into the third year at this location, the community recognizes this space as the permanent location for the Winter Market.

Since moving into this new space, CFM surpassed its goals to increase the number of specialty crop vendors from 17 in 2010, 15 in 2011, 18 in 2012 and 25 in 2013. The number of vendors applying to participate in the 2013/2014 season reached such a high number that new vendors have been placed on a waiting list. CFM surpassed its goals to increase the number of customers as well; from 250 in 2011, 612 in 2012 and 960 in 2013.

We believe that a significant factor in this successful winter market has been the use of radio, television, print and social media outlets for advertising the existence and location where traditional customers can buy fresh specialty crops from their favorite growers even in the winter months. By using various avenues for advertising, CFM was able to reach a wide array of customers. Originally, radio was the only advertising outlet planned, but CFM found that by utilizing more outlets (print, social media, and some video) they were able to reach more diverse types of customers. CFM successively held a Fall Roundup in its first year of the grant, 2010. This event was attended by 40 vendors and families. It became apparent that CFM was unnecessarily duplicating programs already offered by other entities (Great Plains Growers Conference, Missouri Organic Conference,

and Missouri Farmers Market Association). Together with Missouri Vegetable Growers Association and the University of Missouri Extension, which hosts farm tours throughout the year, CFM's board elected to curtail Fall Roundup events and focus on attracting local winter market customers. Therefore in 2011, the speaker at the Winter Kick-Off served this purpose. In 2012, at the Fall Vendor meeting CFM had a speaker on local weather trends, with 27 farms attending. In 2012 and 2013, CFM's Winter Market Kick-Offs took place during opening days of the Winter Market. Many vendors at these Winter Market Kick-Offs provided samples of their specialty crop products, demonstrations, free musical performances, and children's activities organized by partners, the Southern Boone Learning Garden and the AmeriCorps VISTA volunteer. In December 2013, CFM decided to hold another Fall Roundup with 25 farms attending. CFM members donated all of the additional ineligible non-specialty crop products. No funds from the SCBGP were used to purchase food for the Winter Market Kick-Off.

One important task during the grant period was to ensure that all efforts supported through SCBGP funds promoted only specialty crops. Only photos and words of locally grown specialty crops were used in the advertising. SCBGP funds used for the Winter Market Kick-Offs promoted specialty crops through meals, sampling and education. CFM matched SCBGP funds at the Winter Market Kick-Offs promoting only specialty crops. All educational forums held educated vendors and customers on specialty crops. With well over 50% of CFM vendors at the Winter Market being specialty crop vendors and by providing an outlet for specialty crop vendors to sell their produce the funds definitely enhanced the competitiveness of specialty crops.

CFM matched SCBGP funds. CFM matched the Winter Market Facility Rental costs through insurance coverage, additional rent costs and snow removal. CFM matched personnel expenses. At the Winter Kick-Off Dinner, CFM matched SCBGP funds by covering the expenses for the chef, supplies and all food served. At the Winter Kick-Off dinner in 2011, specialty crops were donated by the specialty crop vendors for the chef to prepare. Any additional ineligible non-specialty crop products needed to supplement the menu were also donated by CFM vendors. The menu had such dishes as roasted root vegetables (carrots, potatoes, parsnips, sweet potatoes), braised winter greens (kale, Swiss chard, mustard greens), apple and pecan pie and roasted squash and apples all highlighting and benefiting specialty crop items and vendors. At the Winter Kick-Off events held in 2012 and 2013 CFM vendors donated specialty crop items as water cress, apples, parsnips and squashes for customer sampling. CFM matched funds for advertising costs. CFM matched funds for the Fall Roundups that occurred in 2011 and 2013.

Goals and Outcomes Achieved

All goals and activities discussed in the original grant proposal have been completed.

Goal 1 was to establish a successful long-term Winter Market with a secure location. CFM was able to secure a location at Parkade Plaza that can hold up to 50 10x10 stalls. During the 2010 Winter Market 13-17 specialty crop producers sold at each winter market, the 2011 Winter Market had 10-15, the 2012 Winter Market 15-18 and by the beginning of the 2013 Winter Market, 47 vendors were attending the market with 25 being specialty crops vendors. At the end of the 2012/2013 market CFM polled it's vendors regarding the Winter Market's successes. 90% of the vendors who participated in the 2012-2013 Winter Market returned to the 2013/2014 Winter Market. 100% of them were very satisfied with the market being located at Parkade Plaza and planned on returning to sell at the market again in 2013/2014 season. 58% of the vendors reported their sales had increased from the previous Winter Market, 35% reported that sales remained stable and 7% reported a decrease.

Goal 2 was to organize Fall and Spring Roundup Meetings. CFM organized a Fall Roundup in 2010, but it became apparent that other entities were offering duplicate programs therefore CFM held small informational events in 2011 (speaker at the Winter Kick-Off, with around 52 families attending) and 2012 (Fall Vendor Meeting, 27 farms attending). In 2013, CFM decided to hold a Fall Roundup

again, with 25 farms attending. At the 2013 Roundup CFM had an educational forum for CFM vendors designed to educate vendors on issues they will be facing in the next few years with pests and GAP regulations. The Forum also educated the vendors on how to utilize technology to their advantage (sales tracking, tax calculations, customer databases, etc.). The new Market Manager is in the process of transitioning the Farmers Market records to a digital storage system with online databases.

Goal 3 was to hold a Consumer Kick-Off for Winter Eating each year. CFM successfully held three “Consumer Kick-Off” events. CFM adjusted the format of the second and third events from the original proposal, holding them at the opening Winter Market. At these Kick-Offs, CFM educated customers on how to eat locally, healthy and seasonally, as well as having demonstrations on how to prepare specialty crops and help them get to know their famers. In 2011 we had 52 families attend the Winter Kick-Off event dinner (ticketed event), in 2012 400 customers attended the Winter Kick-off event (at the market and open to the public) and in 2013 960 customers attended the Winter Kick-Off event (at the market and open to the public). At the Winter Kick-Off dinner in 2011, specialty crops were donated by the specialty crop vendors for the chef to prepare. The menu included items such as winter greens, root vegetables, winter squash, etc. At the 2012 and 2013 Winter Kick-Off events, CFM specialty crop vendors handed out samples of their produce for customers to taste. With the successful implementation of the Winter Market Kick-Off events the winter markets have increased the number of specialty crop vendors and customers each year. The Specialty Crop Grant funds have been invaluable in providing the support to CFM to organize events to introduce Columbia consumers to the Winter Market.

Goal 4 was to increase customer traffic during winter market. CFM’s original goal was to increase its weekly customer count from 120 to 480 customers through the grant period. CFM successfully surpassed this goal with a weekly average of 250 customers in 2011, 612 in 2012 and 960 in 2013. CFM additionally reached out to an underserved population near the winter market location with an advertising campaign of the market’s ability to accept EBT/Food Stamps. CFM saw an increase in the number of EBT tokens that were purchased each year of the grant.

CFM’s long-term goal was to establish a successful Winter Market and in turn provide an outlet for specialty crop growers to sell healthy, fresh produce to customers year-round. Each winter the market continues to increase its number of specialty crop and non-specialty crop vendors, customers and total dollar value of goods sold. CFM advertised through a number of radio, television, print and social media to reach as many different types of customers informing them that they can access healthy, fresh local produce at the winter market. CFM ran 5 newspaper ads, 20,000 door hangers were printed and distributed throughout the community, 414 radio spots ran on 6 different stations and 1 television ad ran. All ads promoted specialty crops at the Winter Market.

Since the beginning of this grant CFM has moved to Parkade Plaza, a larger location than the originally planned location, Rockbridge Christian Church. Parkade Plaza has enthusiastically supported CFM’s Winter Market throughout the last three years and is excited to continue and expand the relationship.

Activity	2011-2012 Mkt	2012-2013 Mkt	2013-2014 Mkt
# of vendors	17	34	47
# of specialty crop vendors	15	18	25
Highest # of weekly customers	250	612	960
# attending Winter Market Kick-Off	52	400	960
Number attending Fall Roundups or other Educational Events	52	27	25

Beneficiaries

The community benefited greatly from the implementation of this grant project. Residents of Columbia, Missouri can now access locally grown healthy food year-round. Through special events, print, radio and television advertising, word of mouth, and an aggressive marketing campaign during the summer markets, CFM was able to inform the community about access to healthy local food year-round. In addition, lower income families can come to the market and swipe their EBT card in exchange for healthy food.

The farmers of in the community have also received benefits from this project. CFM is strictly a producer-only market and vendors must be living and farming within a 55 mile radius of the market. These rules ensure market customers that they are getting locally grown produce, grown and raised by the farmers they are buying from at the market. By creating this year-round outlet, these hard working famers are able to continue growing food year round and expand their local businesses.

A third success is the growing business partnership between CFM and the managers of Parkade Plaza. Parkade Plaza supplied CFM with a space at a discounted rate for three winter seasons (including the current winter season). Due to CFM's weekly presence at Parkade Plaza, private and special events business have grown tremendously and improved traffic at small restaurants located in the center. CFM and Parkade Plaza are now brainstorming how to expand their business relationship, such as locating a Columbia Farmers Market office space in the Center.

Parkade Plaza charges CFM a weekly fee to use its space to cover the rental fees, operating expenses and staffing required to host the Winter Market in their space. Due to increased rent costs at Parkade Plaza, CFM raised its fees to participating vendors; \$20 each week for 2013 Columbia Farmers Market members and \$30 for non-members. Parkade Plaza charged CFM \$200 per week in 2011/ 2012 fees and \$300 per week in 2013.

CFM has also worked closely with its sister organization, Sustainable Farms and Communities (SF&C) to provide affordable healthy food to low income families through the Access to Healthy Food Program. Through this program SF&C has been able to match EBT purchases up to \$25 each week for families with children under the age of 10. In the 2012 market year CFM had 93 participants in the program and in 2013 they had 120. The match program was not funded by SCBGP funds. EBT match funds were unavailable during the 2013/2014 Winter Market, yet CFM has continued to see an increase EBT purchases. In December 2012 when SF&C was able to provide EBT match funds we saw \$647 tokens purchased with \$480 matched. In the December of 2013, with no match program available, we had \$853 EBT tokens purchased. Even without the match program CFM has seen in increase in EBT users at the Winter Market.

Lessons Learned

CFM has learned that in order to execute a long term, multiple year project such as this grant, they need to have more continuity with its staff and Board members. The turnover in Columbia Farmers Market staff and Board Members has created a situation where continuity of executing, tracking and reporting the activities of the grant was challenging. The Columbia Farmers Market staff and it's Board Members who are committed to working with the market vendors to help the organization be successful.

Contact Person

Corrina Smith, Market Manager
573-864-9791

Additional Information

CFM has also updated and expanded their website, www.columbiafarmersmarket.org, with the help of the new Market Manager. CFM has created a weekly newsletter sent out to customers each week, informing of new products, events, community activities and vendor spotlights. Example newsletter: <http://myemail.constantcontact.com/CFM-News-11-2--We-Move-Indoors-.html?soid=1101877013331&aid=KELMoc2jdh4>

Through the use of the Specialty Crop Grant the Columbia Farmers Market has been able to create a Winter Farmers Market in a spacious location under roof that accommodates a growing number of producers selling locally grown food during the winter months. Through use of the SCBGP funds, CFM was able to publicize the winter market and expand the number of customers who are attending the winter market and buying locally grown food on a regular basis. CFM has also expanded the number of low-income families who are accessing healthy locally grown food at the winter market through the use of the USDA Supplemental Nutrition Assistance Program. CFM appreciates the support to help expand access to locally grown specialty crops throughout the year in central Missouri.



Specialty Crops vendors' at
the Columbia Farmers' Market





Children's activities booth
at the Opening Day
Market Celebration

Activities were run by the
Southern Boone Learning
Garden and our
AmeriCorps VISTA
volunteer.

Project 2: Introducing Flash Freezing Technology to Missouri Specialty Crop Growers

Missouri Department of Agriculture

Final Performance Report

Charlie Hopper, Marketing Specialist

Project Summary

The purpose of this project was to build a mobile flash freezing unit to educate Missouri fruit and vegetable producers about flash freezing technology. After the initial season of outreach the unit was made available for use by growers to extend the marketable life of their products. Scheduling, transportation and use of the unit was to be managed collaboratively by the Missouri Department of Agriculture, University of Missouri Cooperative Extension and the Missouri State Fruit Experiment Station. No other funding was requested for this project.

The project was designed to address issues related to the seasonal nature of specialty crops. Missouri grown fruits and vegetables have narrow windows of availability. Season extension tools such as high tunnels are being readily adopted by growers as a way to extend the growing season and marketability of their crops. A flash freezing unit offers another tool to significantly increase the

marketable life of many fruits and vegetables. Having frozen products can open new marketing channels. Growers with freezing capability will be able to plant more crops and preserve them for off season sales. The ability to freeze unsold fruit and produce will decrease the amount of waste generated through over production and market trends.

Fruit and produce must be frozen individually in single layers to create a high quality frozen product. This allows the product to hold its natural shape and not clump together in the container. It requires a lot of space and flash freezing is the only way to economically process large amounts of product.

Current trends in consumer behavior and the economic climate made this an ideal time to implement this project. Consumers are more willing to purchase locally grown products. During the winter months this market is not being served and consumers are forced to purchase products grown elsewhere.

School administrators are very interested in purchasing locally grown products to serve in cafeterias. The Farm to School program is generating a great amount of interest between growers and school districts for getting Missouri grown foods into the schools. Currently, very few locally grown products are available during the school year. Cafeterias rely on frozen foods as a large part of their menu items during the winter months. Having locally grown frozen fruits and vegetables available for schools during the winter months can open up necessary markets for local specialty crop producers. As our youth understands less and less about food production and farming; these partnerships between producers and schools can open doors for educational opportunities and bring a broader consumer base to the local specialty crop industry.

The current economic downturn has caused many Missourians to lose their jobs and look for other forms of revenue. Flash freezing is a way for growers to add value to their crops while producing products that entrepreneurs' can further process into marketable products.

Program Objectives

1. Design and build a mobile flash freezing unit to serve as a training tool and to be utilized by Missouri farmers to preserve fruits and vegetables
2. Educate 750 growers on using this unit and on the requirements for building a unit for their farm
3. Increase the revenue of Missouri specialty crop growers by \$100,000 during the second year of the project by making the unit available for growers to use

To help meet the educational component of this project we built on the success of the vegetable farm tours that have been previously funded through SCBGP funds. Several hundred growers attend these tours each year to learn new ideas that will improve their operations. Displaying the unit and educating growers on its use at the farm tours has enormous potential for impact because the target audience of growers searching for new ideas will already be assembled.

Project Approach

Building the trailer became a major project and educational tool in itself. The University of Missouri's School of Agricultural Engineering was engaged to design, procure and construct the trailer. As a result, manuals to operate, maintain and construct the trailer were also created. These drafts proved vital to implementing the outreach component of the grant. With the outreach activities completed, revisions to the manuals will be made as needed to accompany the trailer and assist producers in future freezing efforts. Further funding is being investigated and secured to help continue the outreach efforts and printing of materials going forward. Over the course of the project, this objective proved to

be the most time consuming and face the most hurdles in meeting the objectives due to the research and discovery required to complete the task.

While the original project was designed to create a tool, it quickly became evident the real task was to design a program and processes. Just like someone who designs a commercial kitchen realizes, it is not the space that is under inspection, it is the processes that occur in it. Not only did processes have to be developed for the trailer itself, they also had to be created for everything that occurred in it. Just as every piece of equipment and feature of the trailer needed instructions and record keeping, so did all produce processed and activities occurring in the trailer.

Many of the same hurdles that are faced with community based commercial kitchens also occurred with the trailer. When someone uses a commercial kitchen, the person who owns and manages the space takes responsibility for what occurs in it, even if they are not liable for the product that comes from it. The owner of a shared space is responsible for ensuring records are maintained and that Sanitation Standard Operating Procedures (SSOP) is followed by the producers. The producer may have Good Agricultural Practices (GAP) or Good Handling Practices (GHP) requirements for what they produce and part of SSOP is ensuring and recording that those are adhered to as well. If not, any certifications required for the trailer or kitchen could be jeopardized. In the end, designing and building the trailer became as much about designing these processes and a space to ensure they could be followed as the equipment itself.

As a result, the first objective of building a mobile flash freeze unit to serve as a training tool to preserve fruits and vegetables was completed and the usability of the unit exceeded expectations. Several additions were made to elevate the unit to a space that could be certified by local health agencies. Some locations require any food preparation to be done under inspection, even if frozen products are not considered to be potentially hazardous. This also made the unit suitable for preparing produce for consumption as well as prepared foods, expanding opportunities for producers to add value. Finally it made the unit ideal for providing demonstrations on food safety related to the implementation of the food safety modernization act and Missouri's new food code. This increased demand for the use of the trailer from producers, to state and local health agencies as well. In turn, it increased the ability of the trailer to promote specialty crops as a whole.

Once the trailer was constructed, implementing the outreach and production components became the focus. The outreach component included several demonstration events designed to reach producers from across the state and greatly exceeded two of the three program objectives. The second objective of educating 750 producers was greatly exceeded as well.

Due to the need to maintain custody for SSOP, instead of going to several remote areas for the demonstrations, existing opportunities with synergetic programming were utilized to roll out the trailer. MDA contracted with MU's Bradford Research Center in the summer of 2013 to complete this work. Kerry Clark, Sr. Research Specialist was in charge of the transport and setup of the unit. Leslie Touzeau, Research Specialist conducted outreach and demonstrations at the events. MU was given \$4,654 to conduct the outreach and to maintain and transport the trailer.

On August 1, 2013 the unit was exhibited at the Bradford Farm Organic Field Day to over 300 producers and educators. The unit moved from there to the Missouri State Fair and was exhibited from August 8 - 18, with three demonstration days being conducted. Opening day is the day that horticulture awards are announced, gaining exposure to over 500 specialty crop producers in the first day. The two Saturdays were also chosen as they are traditionally the most attended days. Finally Legislative Day was included as a way to demonstrate the impact of specialty crops and the potential of the technology and infrastructure to policy and law makers. At the Missouri State Fair alone, with over 366,000 attendees, more than 5,000 producers were educated about the trailer.

MU also exhibited the trailer at two other high profile events. Lincoln University Vegetable Festival on August 28 was attended by 250 producers specifically looking at applications related to peppers and tomatoes. The Bradford Tomato Festival on September 6 was also used as a demonstration site and attended by over 1,000 producers. Future Farmers of America (FFA) Field Days at Bradford Farm also exposed the trailer to over 1,000 students and educators. Several crops were demonstrated at the events. Due to the late season timing, the most common used were tomatoes, peppers, peaches, squash, zucchini, melons and blackberries. While the quantity desired in the third objective of \$100,000 was not available or reachable, the quality and potential for such impact was easily demonstrated.

In addition to the outreach performed, MU's Bradford staff has started developing a strategic plan for the flash freezer unit including research into public health regulations, training in food safety by Leslie Touzeau, developing an operator's manual for farmer clients and a website for information and rental of the flash freezer. These plans will be further developed in 2014 as potential funding is identified.

Goals & Outcomes Achieved

Of the three primary objectives, the first two were exceeded greatly. Over 7,000 producers were educated about the technology and exposed to the application of it, well over the initial target of 750. The trailer well exceeded expectation both in content and application, as documented above. The third goal of adding \$100,000 to the market place was not met during the growing season. However, it became clear how the goal could be met if the mobility of the unit were limited. Having the trailer located at Bradford Farm will make this very feasible between the use of neighboring CSA's that sell produce directly to consumers and the ability of the farm to supply produce for the University of Missouri's food vendors. In the end, the overall objective of showing the value of adding this technology on the farm was easily achieved.

The most common response and likely result from those who were exposed to the trailer was that returns could be gained with flash freeze technology. However, most agreed the technology needed to be stationary on the farm to work with the farmers' schedule or it needed to be at a set location where someone else could provide the service such as a food hub. Both options would add significant cost to the producer and most producers indicated they would need to be engaged in direct sales with consumers to recuperate that cost.

Many farmers have and continue to contact the department as they explore adding this technology to their operations. The growth in preparation for GAP certification has added a good window of opportunity and time of investment in infrastructure to make this feasible. The positioning of the existing trailer at Bradford farm also creates semi permanent hub facility that will be able to be moved a few times a year to other regions. As a natural progression, the trailer and quality of the product also spiked interest by entities trying to develop food hubs as a possible service to create viable financial models. At least two of the five food hubs currently under development are working to add this technology

Beneficiaries

Missouri's producers were the primary financial beneficiaries of this project due to the education received, future tools for education created, and the ongoing availability for use of the trailer. The University of Missouri Cooperative Extension Service and Bradford Research Farm will be able to use the trailer well into the future to grow the promotion of specialty crops. Missouri consumers will have the added availability of local produce throughout the winter. The Missouri Department of Agriculture (MDA) benefits in knowing that producers can increase their revenue and quality through flash freezing. MDA also gains the added benefit that increased opportunities to improve food safety will

occur due to the completion of this project. With the trailer located and staffed at Bradford Research Farm, the increased production of \$100,000 per year should be exceeded in the future and a sustainable financial model to manage the trailer and its use should be achievable.

According to the 2007 Ag Census, there were less than 2,000 fruit and vegetable growers in Missouri. The number of growers who attended trainings on the trailer was more than triple that number. As mentioned above, the direct impact of this grant definitely helped to educate over 2,000 active fruit and vegetable growers. This resource will continue to be used by hundreds for production in its continued use at Bradford Farm. It will also be exposed to thousands more in MU's outreach and research activities. With the integration of this technology into food hubs as a result of this effort, hopefully it will result in more growers adding vegetable production that do not want to engage in direct sales. In the end, this project has and will continue to open doors for fruit and vegetable farmers and those who may want to enter into it.

Lessons Learned

The biggest lessons learned on this project are that flash freeze technology is a viable means to add value and profit for fruit and vegetable producers, the process on such a project can easily outweigh the product, and that mobile technology adds more value the less mobile it is.

Without a doubt, the trailer produced a higher quality product than could be produced through traditional freezing or canning in less time. With proper storage space, farms could increase revenue by stretching product availability through winter with a higher quality and price that could be achieved by conventional means. Especially in the areas of CSA's or institutional supply opportunities, flash freezing can fill a market void.

The old saying a tool unused is a useless tool has some application here. If there is no one to make sure the tool is used, it is also useless. A project like this requires the team to make it happen and manage the process as much as it requires the tool itself. Food production does not become simpler because it is mobile, if anything it becomes more cumbersome and that has to be taken into financial and logistical planning.

Finally, mobility is good for exposing the technology for education purposes. However the cost of moving the unit can quickly outweigh the added value of using the unit if it is moved too often. It was difficult to move and stage the trailer anywhere in the state (short or long distance) in under a day's time. Considering it takes another day to move it when the work is complete, one can easily spend more time and money moving the trailer than is gained using it. The trailer is ideal for housing in a centralized location and use by multiple farmers or using for educations, but as a mobile means of production, it may be easier for a producer to recover their costs if they installed their own unit.

Contact Person

Charlie Hopper, Marketing Specialist
573-522-4170
Charlie.Hopper@mda.mo.gov







Project 3: Studies on the Interactive Effects of Row Orientation and Canopy Management Practices on Growth, Yield and Fruit Composition of Norton Grapes

University of Missouri, Institute for Continental Climate Viticulture and Enology

Jackie Harris, Eli Bergmeier, Keith Striegler, Renee Threlfall, Ingolf Gruen
Final Performance Report

Project Summary

The principle purpose of this project was to enhance the competitiveness of Norton grapes and wines in the marketplace by improving yield, fruit and wine quality from Norton grapes grown in the Central

U.S. Norton, the state grape of Missouri, is the most widely planted grape in the state and is the flagship wine for many wineries but is a challenging grape to vinify due to its high malic acid content and pH at harvest. Additionally, Norton is a challenge to grow due to its vigorous growth and often excessive canopy density, which may limit fruit and wine quality. Little published research is available to guide producers in managing Norton grapevine canopies for quality wine production. The project culminates five years of research effort on Norton in Missouri and has allowed the investigators to determine the impact of row orientation on Norton grapes and identify canopy management practices that promote development of sound canopy architecture and high fruit and wine quality.

Project Approach

Project was initially started in 2008 and was continued through the 2011 season at a commercial Norton vineyard in Gasconade County, MO.

Experimental Procedures:

Location: Hermann, MO

Spacing: 8' x 11' (vine x row)

Training System: Bilateral High Cordon

Row Orientation: East-West and North-South

Soil Type: Menfro Silt Loam (ID 60001)

Year of Planting 2001

Treatment details and experimental design:

This is a factorial experiment comparing two row orientations and 8 canopy management treatment combinations. The experiment site is unique because it features vines of the same age planted on identical soils to both north-south and east-west row orientations. Row orientation is the main factor. The sub-factor is canopy management practice, for which shoot thinning (ST), shoot positioning (SP), and leaf removal (LR) alone plus all possible combinations were executed in addition to a non-manipulated control. The experiment features a factorial randomized block design with six replications and three vine plots per treatment. Vegetative growth data collected include canes per vine, pruning weight, and cane weight after pruning, utilizing a 50+10 pruning severity formula. Vines were pruned with 6 node fruiting canes and renewal spurs. Physiological parameters assayed include photosynthetically active radiation (PAR) in the fruit zone as well as canopy assessment utilizing point quadrat analysis.

Measurements of fruit composition include percent soluble solids, titratable acidity, juice pH, anthocyanins, tannins, total phenols, organic acids (tartaric, malic, and citric), carbohydrates (fructose and glucose), and juice mineral nutrient concentration. These parameters were assayed by standard methods from samples collected at the time of commercial harvest. Yield data collected included fruit yield per vine, berry weight, cluster weight, and berries per cluster.

Statistical analysis of all results was performed by analysis of variance (ANOVA) with current versions of Statistical Analysis Software (SAS; currently version 9.2).

Canopy management treatments

Canopy management treatments for each year started with shoot thinning in early May when the shoots were 6-8 inches in length. Shoot positioning and leaf removal was performed every couple of weeks or as necessary in May through September to maintain the experimental treatments.

Assessment of canopy architecture

Assessments of canopy architecture and fruit microclimate in the canopy management experiments were made in late September shortly before commercial harvest to assure presence of a full leaf

canopy and fair representation of the entire growing season. Harvest dates were September 27 and September 24 for 2010 and 2011, respectively.

Fruit analysis

Basic fruit composition (percent soluble solids, pH, and titratable acidity) were determined within 48 hours after sampling. Juice was collected from fresh samples and prepared for mineral analysis. A second sample from each treatment was also frozen immediately after sampling to facilitate subsequent determination of anthocyanins, phenols, and tannins through spectrophotometric means and organic acids and carbohydrates by high performance liquid chromatography (HPLC). Samples measured by spectrophotometer and HPLC were normally completed by March, except for in the final year of study when spectrophotometer samples were completed in August 2012.

Vegetative growth

Vegetative growth was assessed over winter during pruning which started in January and was completed in March of each year.

Due to incomplete funding and problems with the canopy management, a portion of the experiment was removed from the study. Specifically, vines pruned and prepared for the shoot density experiment were accidentally shoot thinned by the cooperators' crew; thus, making the experiment unusable. No problems or delays were seen in the row orientation x canopy management study. Field measurements were completed in a timely fashion by the ICCVE.

Laboratory analysis was delayed due to time constraints resulting with a request for time extension to complete color analysis of samples collected and frozen from the 2011 season. A no cost extension was granted on July 8, 2012 which extended the project to December 31, 2012.

Goals and Outcomes Achieved

The goals and outcomes of the project were as follows:

1. Identify optimum canopy management practices, which can be recommended to Norton grape growers.
2. Enhanced fruit composition of Norton wines to be more competitive in the global wine market.
3. Improve Norton grape and wine quality and eventually profitability.

The project was built upon two previously funded projects, "Influence of Cluster Exposure to the Sun on Fruit Quality and Composition of Norton Grapes" (FY 2009) and "Assessing the Impact of Canopy Architecture, Microclimate and Cluster Exposure on Norton Grapevines" (FY 2010). Data for years 2009, 2010, and 2011 are presented in Tables 1-3, 4-6, and 7-9 respectively. The main effects of row orientation, canopy side and canopy management practice on yield in 2009 are given in Table 1. For ease of interpretation, it should be noted that yield, clusters/vine, cluster weight, and berries/cluster data represent partial vine values, while berry weight data represents a whole vine value. North-South (N-S) row orientation produced higher yield, clusters/vine, cluster weight and berries/cluster than the East-West (E-W) orientation. E-W rows had a slightly higher berry weight than N-S rows. The side of the canopy receiving afternoon shade had a higher yield and clusters/vine in comparison with the sun side. Cluster weight and berries/cluster were greater for clusters in the afternoon sun side of the canopy. Yield and clusters/vine were lower for vines which were shoot-thinned. Vines which were SP or ST + SP had greater cluster weight than control, ST, or ST + SP + LR vines. Berry weight was higher in LR and SP vines than in ST + SP + LR vines. ST + SP treated vines exhibited more berries/cluster than Control, LR, ST, or SP + LR treated vines.

Row orientation, canopy side, and canopy management practice influenced fruit composition in 2009 (Table 2). All fruit composition data represent whole vine values. E-W row orientation resulted in higher soluble solids, anthocyanin content, phenolic content, and tannin content. In addition, pH and malic acid level were lower in E-W oriented rows. Canopy side data were somewhat variable. The canopy side receiving afternoon sun had greater percentage soluble solids and phenolic content, while the shade side had more potassium and tannins. SP + LR vines had higher percentage soluble solids than ST vines. Fruit pH was greater in ST vines than in SP, LR, SP + LR, ST + LR, or ST + SP + LR vines. SP produced higher titratable acidity than SP + LR, ST + LR, ST + SP and ST + SP + LR. Potassium content was highest for Control vines and vines receiving ST. All treatments except ST had a lower malic acid level than the Control.

Anthocyanin content was greatest for ST + LR vines and lowest for SP vines. ST + LR vines had the highest concentration of phenols and Control vines had the highest tannin content. Vegetative growth of Norton grapevines was altered by row orientation, canopy side and canopy management practices in 2009 (Table 3). It should be noted that shoot and pruning weight data represent partial vine values, while point quadrat data (canopy gaps, leaf layer number, percentage interior clusters, and percentage interior leaves) represent whole vine values.

N-S row orientation produced more shoots/vine, pruning weight, leaf layer number and percentage interior leaves than E-W orientation. The shaded side of the canopy in afternoon had more shoots, pruning weight, and canopy gaps than the sun side of the canopy. Canopy gaps would be expected to be greater on the shade side since only this side received leaf removal. ST reduced shoots/vine in all vines receiving this treatment, but the reduction was not always statistically significant. Pruning weight was lowest in vines which received SP. Point quadrat data responded to the LR treatment. Canopy gaps were higher while leaf layer number, percentage interior clusters and percentage interior leaves were reduced by LR treatment.

Row orientation, canopy side, and canopy management practices influenced yield and yield components in 2010 (Table 4). In contrast to 2009, row orientation did not significantly affect yield. Clusters/vine was higher for E-W rows while cluster weight and berries/cluster were higher for N-S rows. The side of the canopy with afternoon shade had more clusters/vine and slightly higher yield. SP and SP + LR treated vines had greater yield and clusters/vine than vines which were treated with the other canopy management practices. ST + SP vines had larger clusters than ST + SP + LR, SP + LR, SP, or Control vines. Differences in berry weight were recorded, but their magnitude was quite small. Control, SP, and SP + LR vines had fewer berries/cluster than ST, ST + LR, or ST + SP vines.

Fruit composition data for 2010 are given in Table 5. E-W row orientation displayed higher soluble solids, pH and anthocyanin content. Titratable acidity and malic acid content were greater for N-S row orientation. Canopy side had almost no effect on fruit composition. The sun side had slightly higher percentage soluble solids than the shade side. LR, SP + LR, and ST + SP vines exhibited higher percentage soluble solids than Control, ST, and ST + LR vines. Fruit pH was greatest for Control and ST vines as compared to other treatments. Seasonal variability in fruit acidity was evident when titratable acidity was compared between the 2009 and 2010 seasons. Levels of titratable acidity in 2010 were about half of the values recorded for 2009. SP and ST had higher titratable acidity than SP + LR, ST + SP, or ST + SP + LR. The lowest potassium and malic acid levels were detected in vines which received ST + SP + LR. LR vines had greater anthocyanin content than ST + SP vines. Phenolic and tannin levels were not significantly affected by canopy management practice.

Vegetative growth was impacted by row orientation, canopy side and canopy management practices in 2010 (Table 6). Shoots/vine and pruning weight were higher in N-S than E-W rows. Point quadrat parameters were not significantly affected by row orientation. The side of the canopy which received afternoon shade had more shoots/vine and canopy gaps than the sun side. Leaf layer number, percentage interior clusters, and percentage interior leaves were higher on the afternoon sun side of the canopy. The canopy side point quadrat data reflect the location of leaf removal.

As was observed in 2009, ST did not consistently reduce the number of shoots/vine. Treatments which were shoot positioned had less pruning weight, which was consistent with the previous year's data. All treatments with LR had more canopy gaps as well as lower leaf layer number and percentage interior clusters of leaves when compared with non-LR treatments.

Yield and yield components data are presented in Table 7. N-S row orientation exhibited greater yield, cluster weight, berry weight, and berries/cluster than E-W orientation. Yield and clusters/vine were higher on the side of the canopy with afternoon shade. Cluster weight, berry weight, and berries/cluster were not impacted by canopy side. Yield was greatest for vines which were SP and lowest for vines which were ST. Clusters/vine displayed a similar response to canopy management treatment. Control and ST vines had smaller clusters than SP, SP + LR, ST + LR, ST + SP, and ST + SP + LR vines. Statistically significant differences were recorded for berry weight but the differences were small and of little practical significance. Berries/cluster were higher on ST + SP + LR vines than on Control, LR, ST, SP + LR or ST + LR vines.

Fruit composition was altered by row orientation, canopy side, and canopy management practices in 2011 (Table 8). E-W oriented rows had higher soluble solids, pH, anthocyanin content, and phenolic content with lower titratable acidity, potassium concentration, and malic acid concentration. Canopy side had a limited impact on fruit composition. The afternoon sun side of the canopy had higher soluble solids and pH than the shade side. Canopy management effects on fruit composition were minor. However, fruit from the ST + SP + LR treatment tended to have somewhat better values than the other treatments.

Row orientation, canopy side, and canopy management practices had a significant impact on vegetative growth in 2011 (Table 9). Pruning weight and shoot data were reduced substantially when compared to the 2009 and 2010 seasons. Environmental conditions at this site were extreme in 2011 with vines exposed to high temperatures and water deficit. Irrigation was sporadic due to the vineyard having a limited water supply. It is likely that vegetative growth of the vines was affected by this situation. N-S oriented rows displayed a small increase in shoots/vine and shoot density over E-W rows.

The side of the canopy with afternoon shade had more shoots, pruning weights and canopy gaps than the sun side. Leaf layer number, percentage interior clusters and percentage interior leaves were highest on the sun side. ST treatments reduced shoots/vine and shoot density. Pruning weight was again reduced by SP treatment. Vines receiving LR had more canopy gaps and lower leaf layer number, percentage interior clusters, and percentage interior leaves.

Research results from this study were presented at the 2011 Midwest Grape and Wine Conference on February 7, 2011 and at the Texas Wine and Grape Growers Association Grape Camp meeting on November 6, 2011. The presentation at the Midwest Grape and Wine Conference had roughly 100 attendees while the Texas Wine and Grape Growers Association Grape Camp meeting had 120 attendees. Attendees were primarily made up of grape growers and producers. Results were alternatively presented in these meetings instead of in 2012 due to the PI leaving the University system in 2011.

Beneficiaries

Norton is the most widely planted winegrape in Missouri with over 300 bearing acres. It additionally has significant acreage in surrounding regions. Currently there are over 100 wineries within the state with over half of them producing wine from Norton. As the flagship wine there is potential to increase sales and marketability by improving the fruit and wine quality. The results of this project can be disseminated to grape growers to alter their canopy management practices in order to produce high quality fruit and greater profitability for growers. The results will be presented to growers through a

publication in the Midwest Winegrower and to surrounding regions through an extension publication. Additionally, we will submit the study to a peer reviewed journal.

Lessons Learned

Results from this study provided important insight into methods of altering growth and fruit quality of Norton. Row orientation effects were prominent in this study. N-S row orientation produced higher yield and pruning weight in 2/3 years of the study. However, fruit composition was improved with E-W row orientation throughout the study. These results were interesting and require further investigation. The shade side of the canopy had higher yield (3/3 years) and pruning weight (2/3 years) than the sun side. There was no clear impact of canopy side on fruit composition. Canopy management effects were limited in this study. Shoot positioning reduced vine size and leaf removal was effective in improving the microclimate of the fruit zone. However, with long bearing units (6 node canes), a significant portion of the crop was out of the leaf removal zone. Fruit composition was improved by the full set of canopy management treatments (ST + SP + LR). From these results we can suggest the following recommendations to growers:

- Consider low capacity sites or rootstocks for Norton or select management techniques to restrict vine size.
- Choose divided canopy training systems for Norton on high capacity sites.
- Consider shorter bearing unit than traditionally recommended to achieve a more compact fruit zone that can be uniformly modified.
- Execute shoot positioning and leaf removal treatments as needed to limit vine size and achieve partial cluster exposure to light.
- Shoot positioning is a very useful tool for maintaining vine architecture, which increases the ease of pruning by hand or machine substantially.
- The economics of all canopy management operations must be considered carefully; mechanization of these tasks will improve cost efficiency.

Contact Person

Jackie Harris
573-882-8802
harrisjac@missouri.edu

Additional Information

Table 1. Main effects of row orientation, canopy side, and canopy management on yield and yield components of Norton grapevines. Hermann, MO. 2009.

	Yield (pounds/vine)	Yield (tons/acre)	Clusters/ vine	Cluster weight (g)	Berry weight (g)	Berries/ cluster
Row orientation						
East/West	6.8 b ^b	1.7 b	56.0 b	55.0 b	1.07 a	51.8 b
North/South	8.2 a	2.0 a	64.7 a	58.9 a	1.03 b	57.2 a
Canopy side^a						
Shade	8.3 a	2.1 a	67.7 a	55.5 b	1.06	53.0 b

Sun	6.8 b	1.7 b	53.1 b	58.4 a	1.05 NS	56.0 a
Canopy management						
Control	8.1 ab	2.0 ab	67.8 a	54.9 b	1.04 bc	53.0 bc
Leaf removal (LR)	8.3 ab	2.1 ab	67.0 a	56.1 ab	1.11 a	51.0 c
Shoot positioning (SP)	8.7 a	2.2 a	68.2 a	60.6 a	1.10 a	55.5 abc
Shoot thinning (ST)	6.3 c	1.5 c	51.9 bc	54.1 b	1.02 bc	53.7 bc
SP+LR	8.9 a	2.2 a	70.9 a	56.3 ab	1.07 ab	52.7 bc
ST+LR	6.1 c	1.5 c	48.6 c	57.3 ab	1.03 bc	55.8 ab
ST+SP	7.5 b	1.9 b	55.5 b	61.3 a	1.04 bc	59.0 a
ST+SP+LR	6.5 c	1.6 c	53.1 bc	55.0 b	1.00 c	55.3 abc

^aIndicates afternoon exposure of the canopy to sunlight; Shade=east side of north/south row and north side of east/west row; Sun=west side of north/south row and south side of east/west row.

^bMeans within main effect followed by one or more identical letters do not differ significantly at $\alpha=0.05$ by LSMeans Student's T-Test; NS=Not Significant.

Table 2. Main effects of row orientation, canopy side, and canopy management on fruit composition at harvest of Norton grapevines. Hermann, MO. 2009.

	Soluble solids (%)	pH	Titrateable acidity (g/L) ^b	Potassium (mg/L)	Malic acid (g/L)	Anthocyanins (g/L)	Phenolics (g/L)	Tannins (g/L)
Row orientation								
East/West	23.39 a ^c	3.33 b	15.65	2421	3.27 b	3.62 a	3.37 a	2.83 a
North/South	22.64 b	3.36 a	15.76	2479	4.17 a	3.27 b	2.97 b	2.46 b
			NS	NS				
Canopy side^a								
Shade	22.81 b	3.35	15.69	2494 a	3.76	3.37	3.07 b	2.84 a
Sun	23.22 a	3.35	15.72	2406 b	3.68	3.51	3.27 a	2.45 b
		NS	NS		NS	NS		
Canopy management								
Control	22.90 abc	3.38 ab	16.04 ab	2604 a	4.74 a	3.51 ab	3.21 abc	3.08 a
Leaf removal (LR)	23.18 ab	3.35 bc	15.89 ab	2453 b	3.49 bc	3.32 bc	3.02 cd	2.38 b
Shoot positioning (SP)	22.80 bc	3.31 d	16.52 a	2423 bc	3.75 bc	3.14 c	2.90 d	2.58 b
Shoot thinning (ST)	22.47 c	3.39 a	15.90 ab	2624 a	4.15 ab	3.50 ab	3.20 abc	2.75 ab
SP+LR	23.33 a	3.33 bc	15.15 b	2305 c	3.40 c	3.42 bc	3.19 abc	2.69 b
ST+LR	23.04 ab	3.34 bcd	15.58 b	2449 b	3.41 c	3.75 a	3.41 a	2.66 b
ST+SP	23.19 ab	3.36 abc	15.23 b	2400 bc	3.72 bc	3.34 bc	3.09 bcd	2.57 b
ST+SP+LR	23.22 ab	3.33 cd	15.30 b	2339 bc	3.11 c	3.59 ab	3.35 ab	2.47 b

^aIndicates afternoon exposure of the canopy to sunlight; Shade=east side of north/south row and north side of east/west row; Sun=west side of north/south row and south side of east/west row.

^bExpressed as tartaric acid.

^cMeans within main effect followed by one or more identical letters do not differ significantly at $\alpha=0.05$ by LSMeans Student's T-Test; NS=Not Significant.

Table 3. Main effects of row orientation, canopy side, and canopy management on vegetative growth of Norton grapevines. Hermann, MO. 2009.

	Shoots/vine	Shoot density (shoots/foot)	Pruning weight (pounds/vine)	Canopy gaps (%)	Leaf layer number	Interior cluster (%)	Interior leaves (%)
Row orientation							
East/West	30.3 b ^b	4.1 b	1.3 b	9.2	1.4 b	22.2	12.9 b
North/South	33.2 a	4.5 a	1.5 a	10.8	1.6 a	20.6	16.6 a

				NS		NS	
Canopy side^a							
Shade	35.9 a	4.8 a	1.5 a	16.9 a	1.2 b	19.0	14.0
Sun	27.6 b	3.7 b	1.3 b	3.2 b	1.7 a	23.8	15.5
						NS	NS
Canopy management							
Control	32.7 b	4.3 b	1.9 ab	0.1 cd	2.8 a	47.4 a	40.0 a
Leaf removal (LR)	32.4 b	4.3 b	1.6 b	16.0 b	1.0 d	11.1 de	10.4 c
Shoot positioning (SP)	37.9 a	5.2 a	1.0 c	0.6 cd	1.7 c	32.8 b	11.7 c
Shoot thinning (ST)	27.0 c	3.7 c	2.1 a	0.0 d	2.5 b	31.4 bc	30.9 b
SP+LR	38.4 a	5.1 a	1.1 c	17.2 b	0.8 de	8.0 e	4.8 de
ST+LR	24.7 c	3.3 c	1.7 b	17.1 b	1.1 d	11.7 de	9.4 cd
ST+SP	30.4 b	4.1 b	1.0 c	5.2 c	1.4 c	20.9 cd	8.3 cd
ST+SP+LR	30.8 b	4.1 b	1.0 c	23.9 a	0.7 e	8.0 e	2.3 e

^aIndicates afternoon exposure of the canopy to sunlight; Shade=east side of north/south row and north side of east/west row; Sun=west side of north/south row and south side of east/west row.

^bMeans within main effect followed by one or more identical letters do not differ significantly at $\alpha=0.05$ by LSMeans Student's T-Test; NS=Not Significant.

Table 4. Main effects of row orientation, canopy side, and canopy management on yield and yield components of Norton grapevines. Hermann, MO. 2010.

	Yield (pounds/vine)	Yield (tons/acre)	Clusters/ vine	Cluster weight (g)	Berry weight (g)	Berries/ cluster
Row orientation						
East/West	6.5	1.6	61.7 a	47.6 b	1.05	45.3 b
North/South	6.5	1.6	57.4 b	51.3 a	1.07	48.1 a
	NS	NS			NS	
Canopy side^a						
Shade	7.1 a ^b	1.8 a	65.6 a	49.2	1.06	46.5
Sun	5.8 b	1.4 b	53.5 b	49.7	1.06	46.9
				NS	NS	NS
Canopy management						
Control	6.5 b	1.6 b	60.7 b	48.9 bcd	1.08 ab	45.1 bc
Leaf removal (LR)	7.2 ab	1.8 ab	64.1 b	51.5 ab	1.08 ab	47.8 ab
Shoot positioning (SP)	8.0 a	2.0 a	73.6 a	48.5 bcd	1.12 a	43.4 c
Shoot thinning (ST)	5.2 c	1.3 c	46.6 d	50.0 abc	1.04 bc	48.3 a
SP+LR	7.6 a	1.9 a	73.5 a	47.3 cd	1.06 b	45.0 bc
ST+LR	5.4 c	1.3 c	48.3 d	50.7 ab	1.05 bc	48.6 a
ST+SP	6.6 b	1.6 b	57.7 bc	52.4 a	1.07 ab	48.9 a
ST+SP+LR	5.3 c	1.3 c	52.2 cd	46.1 d	1.00 bc	46.5 ab

^aIndicates afternoon exposure of the canopy to sunlight; Shade=east side of north/south row and north side of east/west row; Sun=west side of north/south row and south side of east/west row.

^bMeans within main effect followed by one or more identical letters do not differ significantly at $\alpha=0.05$ by LSMeans Student's T-Test; NS=Not Significant.

Table 5. Main effects of row orientation, canopy side, and canopy management on fruit composition at harvest of Norton grapevines. Hermann, MO. 2010.

Soluble solids (%)	pH	Titrateable acidity	Potassium (mg/L)	Malic acid (g/L)	Anthocyanins (g/L)	Phenolics (g/L)	Tannins (g/L)
-----------------------	----	------------------------	---------------------	---------------------	-----------------------	--------------------	------------------

(g/L) ^b								
Row orientation								
East/West	21.85 a ^c	3.60 a	8.18 b	2434	4.51 b	2.69 a	1.32	1.56
North/South	21.04 b	3.57 b	8.88 a	2485	5.13 a	2.49 b	1.28	1.55
				NS			NS	NS
Canopy side^a								
Shade	21.31 b	3.58	8.50	2432	4.76	2.60	1.31	1.58
Sun	21.58 a	3.59	8.56	2487	4.88	2.58	1.29	1.52
		NS	NS	NS	NS	NS	NS	NS
Canopy management								
Control	21.18 bc	3.64 a	8.72 ab	2610 a	5.40 a	2.51 ab	1.26	1.44
Leaf removal (LR)	21.76 a	3.57 b	8.49 abc	2393 bc	4.99 ab	2.72 a	1.33	1.39
Shoot positioning (SP)	21.38 abc	3.57 b	8.81 a	2467 b	4.88 bc	2.56 ab	1.29	1.73
Shoot thinning (ST)	20.98 c	3.63 a	8.77 a	2613 a	4.97 ab	2.61 ab	1.32	1.53
SP+LR	21.85 a	3.56 b	8.31 c	2369 bc	4.46 cd	2.62 ab	1.29	1.55
ST+LR	21.20 bc	3.58 b	8.59 abc	2468 b	4.92 b	2.58 ab	1.31	1.57
ST+SP	21.73 a	3.58 b	8.36 bc	2442 bc	4.74 bc	2.49 b	1.26	1.59
ST+SP+LR	21.46 ab	3.57 b	8.20 c	2318 c	4.19 d	2.63 ab	1.33	1.63
							NS	NS

^aIndicates afternoon exposure of the canopy to sunlight; Shade=east side of north/south row and north side of east/west row; Sun=west side of north/south row and south side of east/west row.

^bExpressed as tartaric acid.

^cMeans within main effect followed by one or more identical letters do not differ significantly at $\alpha=0.05$ by LSMeans Student's T-Test; NS=Not Significant.

Table 6. Main effects of row orientation, canopy side, and canopy management on vegetative growth of Norton grapevines. Hermann, MO. 2010.

	Shoots/ vine	Shoot density (shoots/foot)	Pruning weight (pounds/vine)	Canopy gaps (%)	Leaf layer number	Interior cluster (%)	Interior leaves (%)
Row orientation							
East/West	27.9 b ^b	3.6 b	1.6 b	16.4	2.5	68.0	54.8
North/South	29.9 a	3.9 a	1.9 a	15.0	2.4	69.3	54.0
				NS	NS	NS	NS
Canopy side^a							
Shade	32.2 a	4.2 a	1.8	29.6 a	1.8 b	51.5 b	41.9 b
Sun	25.6 b	3.3 b	1.7	1.8 b	3.1 a	85.8 a	66.9 a
			NS				
Canopy management							
Control	27.6 b	3.6 bc	2.1 ab	0.7 b	3.8 a	83.7 a	73.0 a
Leaf removal (LR)	27.0 b	3.4 c	2.1 b	30.2 a	1.8 c	56.5 b	38.6 c
Shoot positioning (SP)	34.8 a	4.6 a	1.2 c	1.4 b	3.0 b	85.3 a	66.4 ab
Shoot thinning (ST)	23.6 c	3.0 d	2.4 a	0.2 b	3.6 a	76.7 a	71.3 ab
SP+LR	36.8 a	4.8 a	1.2 c	28.6 a	1.5 c	55.3 b	40.0 c
ST+LR	23.1 c	3.0 d	2.2 ab	31.2 a	1.8 c	44.9 b	43.9 c
ST+SP	28.5 b	3.7 bc	1.3 c	3.1 b	2.6 b	90.2 a	62.2 b
ST+SP+LR	29.7 b	3.9 b	1.4 c	30.1 a	1.4 c	56.3 b	39.4 c

^aIndicates afternoon exposure of the canopy to sunlight; Shade=east side of north/south row and north side of east/west row; Sun=west side of north/south row and south side of east/west row.

^bMeans within main effect followed by one or more identical letters do not differ significantly at $\alpha=0.05$ by LSMeans Student's T-Test;

Table 7. Main effects of row orientation, canopy side, and canopy management on yield and yield components of Norton grapevines. Hermann, MO. 2011.

	Yield (pounds/vine)	Yield (tons/acre)	Clusters/ vine	Cluster weight (g)	Berry weight (g)	Berries/ cluster
Row orientation						
East/West	5.3 b ^b	1.3 b	52.7	45.1 b	0.96 b	47.2 b
North/South	6.1 a	1.5 a	49.6	54.7 a	1.04 a	52.9 a
			NS			
Canopy side^a						
Shade	6.2 a	1.5 a	54.8 a	50.5	1.00	50.3
Sun	5.1 b	1.3 b	47.5 b	49.3	0.99	49.8
				NS	NS	NS
Canopy management						
Control	5.2 cd	1.3 cd	52.2 b	45.0 c	1.00 abc	45.3 d
Leaf removal (LR)	5.6 c	1.4 c	52.5 b	48.3 bc	1.04 a	46.6 cd
Shoot positioning (SP)	8.3 a	2.1 a	70.1 a	54.1 a	1.02 ab	53.0 ab
Shoot thinning (ST)	3.7 e	0.9 e	36.5 d	45.1 c	0.94 d	47.9 cd
SP+LR	7.0 b	1.7 b	63.5 a	50.3 ab	1.01 ab	49.8 bc
ST+LR	4.6 de	1.1 de	40.5 cd	50.5 ab	1.01 ab	49.9 bc
ST+SP	5.8 c	1.4 c	47.7 b	54.0 a	1.00 bc	53.8 ab
ST+SP+LR	5.2 cd	1.3 cd	46.0 bc	52.1 ab	0.96 cd	54.4 a

^aIndicates afternoon exposure of the canopy to sunlight; Shade=east side of north/south row and north side of east/west row; Sun=west side of north/south row and south side of east/west row.

^bMeans within main effect followed by one or more identical letters do not differ significantly at $\alpha=0.05$ by LSMeans Student's T-Test; NS=Not Significant.

Table 8. Main effects of row orientation, canopy side, and canopy management on fruit composition at harvest of Norton grapevines. Hermann, MO. 2011.

	Soluble solids (%)	pH	Titrateable acidity (g/L) ^b	Potassium (mg/L)	Malic acid (g/L)	Antho- cyanins (g/L)	Phenolics (g/L)	Tannins (g/L)
Row orientation								
East/West	23.86 a ^c	3.46 a	8.99 b	2026 b	5.26 b	2.24 a	1.26 a	3.01
North/South	23.24 b	3.41 b	10.13 a	2319 a	6.69 a	2.08 b	1.22 b	3.00
								NS
Canopy side^a								
Shade	23.46 b	3.43 b	9.64	2181	6.01	2.15	1.23	2.96
Sun	23.64 a	3.45 a	9.47	2164	5.94	2.17	1.25	3.04
			NS	NS	NS	NS	NS	NS
Canopy management								
Control	23.58 ab	3.47 ab	9.74 a	2248 a	6.33 ab	2.11 bcd	1.22 ab	3.10
Leaf removal (LR)	23.67 ab	3.45 bc	9.56 abc	2184 ab	6.02 bc	2.22 abc	1.28 a	3.14
Shoot positioning (SP)	23.13 c	3.41 d	9.91 a	2196 ab	6.44 a	1.95 d	1.13 c	2.67
Shoot thinning (ST)	23.40 bc	3.48 a	9.29 bc	2251 a	5.95 bcd	2.16 abc	1.26 ab	2.94

SP+LR	23.55 ab	3.40 d	9.65 ab	2133 ab	5.87 cd	2.22 abc	1.25 ab	2.90
ST+LR	23.58 ab	3.43 cd	9.50 abc	2145 ab	5.75 cd	2.27 ab	1.30 a	3.20
ST+SP	23.67 ab	3.42 cd	9.64 ab	2141 ab	5.90 cd	2.07 cd	1.21 b	3.07
ST+SP+LR	23.82 a	3.42 d	9.17 c	2083 b	5.56 d	2.28 a	1.29 a	3.02
								NS

^aIndicates afternoon exposure of the canopy to sunlight; Shade=east side of north/south row and north side of east/west row; Sun=west side of north/south row and south side of east/west row.

^bExpressed as tartaric acid.

^cMeans within main effect followed by one or more identical letters do not differ significantly at $\alpha=0.05$ by LSMeans Student's T-Test; NS=Not Significant.

Table 9. Main effects of row orientation, canopy side, and canopy management on vegetative growth of Norton grapevines. Hermann, MO. 2011.

	Shoots/ vine	Shoot density (shoots/foot)	Pruning weight (pounds/vine)	Canopy gaps (%)	Leaf layer number	Interior cluster (%)	Interior leaves (%)
Row orientation							
East/West	22.6 b ^b	2.9 b	0.9	17.0	1.9	67.2	49.2
North/South	25.6 a	3.3 a	0.8	15.5	2.0	68.2	51.7
			NS	NS	NS	NS	NS
Canopy side^a							
Shade	29.5 a	3.8 a	0.9 a	28.5 a	1.5 b	51.0 b	41.4 b
Sun	18.7 b	2.4 b	0.8 b	4.0 b	2.5 a	84.4 a	59.5 a
Canopy management							
Control	23.1 bc	3.0 bc	1.1 a	2.3 b	2.8 ab	84.4 a	64.6 a
Leaf removal (LR)	25.5 ab	3.3 ab	1.0 a	26.8 a	1.3 d	53.1 b	37.9 b
Shoot positioning (SP)	28.3 a	3.7 a	0.6 c	2.8 b	2.5 bc	91.0 a	60.3 a
Shoot thinning (ST)	20.6 c	2.6 c	1.0 a	3.3 b	2.9 a	83.1 a	62.7 a
SP+LR	28.0 a	3.6 a	0.7 b	27.6 a	1.3 d	53.4 b	41.4 b
ST+LR	21.1 c	2.7 c	1.0 a	33.3 a	1.3 d	40.6 b	37.2 b
ST+SP	23.2 bc	3.0 bc	0.6 bc	4.2 b	2.3 c	85.2 a	56.1 a
ST+SP+LR	23.0 bc	3.0 bc	0.7 bc	29.4 a	1.2 d	50.7 b	43.6 b

^aIndicates afternoon exposure of the canopy to sunlight; Shade=east side of north/south row and north side of east/west row; Sun=west side of north/south row and south side of east/west row.

^bMeans within main effect followed by one or more identical letters do not differ significantly at $\alpha=0.05$ by LSMeans Student's T-Test; NS=Not Significant.

Project 4: River Hills Elderberry Producers Grower Support & Value-Added Education Project

Missouri River Hills Elderberry Producers

Terry Durham

Final Performance Report

Project Summary

The intention of this project was to educate potential producers about elderberry production and marketing through on-site visits to conferences and exhibitions, and to provide in-depth information at

the two-day Comprehensive Elderberry Workshop and Farm Tour. The objective was to support and further the education of farmers and agricultural landowners who have committed acreages to elderberries while attracting more elderberry growers. Previous projects, upon which the **Grower Support & Value-Added Education Project** was built, include, **New Crop for a New Age: Innovation and Marketing of Elderberry Plantations and Value-Added Products** in 2009, which launched an education module to encourage elderberry production, resulting in many new growers and additional acreage, and, the **Grower Recruitment Project** in 2010, which built on the project by providing potential growers with information on the marketing advantages and crop production of elderberry plantations, a crop that is under-produced in the United States, resulting in 95% imports of elderberry ingredients, usually in the form of juice.

The Elderberry project is extremely timely as the figure for 2009 imports of elderberry concentrate is reported to be 60,000,000 pounds of product. Elderberry is highly suited to crop and climate conditions in the U.S., and particularly in the mid-section of the country where River Hills Elderberry Producers are concentrating their efforts.

Elderberry has recently been declared a “super-fruit” with excellent antioxidant and anti-viral components, and is highly sought after by a large number of food and beverage manufacturers.

Project Approach

The project used the following objectives to reach out to established and new elderberry producers:

- to formalize research for the mechanical harvesting system through material cost list and engineered drawing phases;
- to research and write a manual on adding value to elderberries;
- to host the second Comprehensive Elderberry Workshop and Farm Tour;
- to purchase advertising in rural publications to promote workshop attendance;
- to exhibit at Farm Shows and Conferences to promote grower interest/Workshop

To host a two-day intensive workshop covering cultural information from propagation to pest prevention, marketing of value-added products, and a farm tour during the flowering season. In order to attract participants the project included placing advertising in key agricultural publications, promotion through speaking engagements and exhibitions at conferences, and increasing interest in elderberries through published articles and the River Hills Harvest website.

Regarding the Mechanical Harvesting Implement, an engineered drawing has been completed to be used to create a piece of equipment. The Opportunities manual has also been completed and disseminated to beginning and existing growers. It includes ideas for growing market and financial as well as recipes. The Elderberry Comprehensive workshop and tour was held in Hartsburg, MO:

<http://www.csacoalition.org/event/comprehensive-elderberry-workshop-farm-tour/>

Regarding advertising for Workshop, there were advertisements in regional newspapers done through Growing for Market and Lees Newspapers. There was signage and display material at all exhibitions and conferences.

Goals & Outcomes Achieved

On-site display and education offerings at local and regional farm conferences and exhibitions: MoRHEP presented information at eight local and regional conferences and trade shows, (up from

five last year) showcasing to 11,900 potential growers, adding 302 names to email list, distributing 2,360 pieces of information from these meetings, (more than double in each category over last year.)

Comprehensive Elderberry Workshop and Farm Tour – over 100 unique potential growers attended the workshop and farm tour held June 9-10, 2011. From that number, 25 Missouri growers attended the MoRHEP cooperative organizational meeting. Production drawings for the mechanical harvesting tool were presented, and each participant received a copy of the Elderberry Value-Added Sourcebook.

Through this project, 50 new growers were reached and 35 additional acres were added. This brings the total since inception to approximately 75 growers with 125 acres basing this off of grower correspondence and cultivar purchases. The number of new growers was met as the benchmark was 30, but the number of additional acres was not met at 35 (benchmark was 125). The total number of acres will be at the point for efficient juicing when these crops get to their full potential of yield within three years. For 2012, River Hills Elderberry Producers will be doing a survey to get a more exact number of growers and acreage.

Through access granted by The Power Hour, a short-wave radio and computer video-stream broadcast, MoRHEP President Terry Durham reached 2 million radio listeners and 200,000 computer listeners which have resulted in over 1000 hits to the RHEP website.

Beneficiaries

The impact of this project will be felt in several sectors. First, growers will increase the value of their farms by planting elderberry, and subsequently harvest a new high-value crop that will increase farm income. Those who become members of the cooperative will multiply their income when their harvests are used to create value-added products.

Each grower will benefit from second-year harvests, which is highly unusual for a perennial crop, at an estimated 350 pounds per acre, which, depending on the degree of value added, will result in returns from \$1.00 to \$5.00 per pound. Third year yields are anticipated to be in the range of 2000 pounds per acre.

Communities will benefit from increased farm value and income, as well as from increased employment opportunities in the form of farm labor and processing employment.

With the aid of this funding opportunity, MoRHEP has come one step closer to educating growers and securing the number of acres necessary to pursue organization as a cooperative.

Lessons Learned

All outcomes were achieved satisfactorily.

The outreach reported surpassed the financial support of this grant, but it was augmented by some exhibitions and conferences offering compensation in the form of hotel nights/travel expenses for MoRHEP representatives.

While farmers and landowners will respond to advertising, they are interested in on-site education tools, being able to see, and discuss the problems, solutions and best practices, whether at exhibitions or at farm tours.

Missouri growers appreciate the opportunity to participate in a cooperative effort that will add-value to their crops, supplying additional income to their farms and increasing return on investment;

- Growers are interested in advances in cropping methods and marketing of new crops that will help sustain their farms and keep agricultural land in agricultural use;
- Growers respond by phone and email to advertising in targeted agricultural publications;
- More rural areas are implementing internet access and growers are beginning to use the services available through the internet, including communication, research, and purchasing.

Contact Person

Terry Durham
573-999-3034
info@riverhillsharvest.com

Additional Information

<http://www.columbiatribune.com/news/2011/aug/30/pushing-purple/>
www.riverhillsharvest.com
<http://urbanhomestead.org/journal/?s=elderberry&submit=go>

The last one is just a great blog –

Project 5: Farm-to-College as a Catalyst for Specialty Crop Production

Truman State University

Michael Seipel
Final Performance Report

Project Summary

This project was designed to create physical and organizational infrastructure to facilitate institutional food purchasing as a catalyst to build demand for and production of specialty crops in northeastern Missouri. The issue that the project aimed to address was the presence of obstacles that limited campus dining services' utilization of locally-produced fruits and vegetables. The project was based on the presumption that part of the obstacles related to physical infrastructure (especially the lack of processing and handling infrastructure to facilitate assembly, washing, packing, storage, and delivery of locally produced fruits and vegetables to college food service providers) and part related to organizational issues, including lack of contact between food service managers and local farmers, lack of awareness of the existence of this demand source by local farmers, and purchasing managers' reluctance to deal with delivery and billing from multiple local growers.

The issue was and remains timely because of the well-documented nationwide growth in local food sourcing in both retail and food service sectors; because of the opportunities that this consumer demand represents for farmers to diversify their product portfolio and market outlets as well as the production landscape of their farms; and because providing college-age students with diverse, local,

and seasonal fruits and vegetables can help shape their palates and purchasing patterns in a way that can impact their life-long food purchasing behavior.

Project Approach

The project utilized a multi-prong approach to achieve its objectives, including developing specialty crop production capacity at the University Farm as a demonstration project for area farmers; training students in specialty crop production; connecting University food service personnel with local producers; developing new market outlets for specialty crops; and raising awareness of locally-produced specialty crops among the campus and Kirksville communities. Specific activities performed during the course of the project including the following:

- As part of this project, Truman State University co-hosted, with University of Missouri Extension and the Missouri Council for Activity & Nutrition, a 'Farm to School Workshop' in Kirksville, MO in January 2011. The workshop brought together area farmers, area educators and food service directors, corporate Sodexo employees and Food Service Directors from other regional Sodexo branches, and representatives from both large and small national, regional, and area food distributors. Total attendance at the day-long workshop included 110 participants.
- Project personnel facilitated contact between the University Food Service purchasing manager and three new food service wholesalers which led to additional purchases of locally- and regionally-produced fruits and vegetables.
- Project personnel facilitated additional marketing opportunities for local specialty crop producers, with eleven new producers over the life of the project having an opportunity to sell to campus dining services and/or at the campus farmer's market.
- Grant funds and matching funds were used to add fruit and vegetable production and handling capacity at the University Farm, which has facilitated increased specialty crop production both at the Farm itself and at other local farms, as producers have utilized equipment and/or facilities at the farm to facilitate their own marketing efforts. Some specific examples include: two acres at the Farm enclosed with deer-proof fencing and used to produce a variety of specialty crops for the first time, including potatoes (red, gold, white, blue), tomatoes, onions, strawberries, okra, summer squash, cucumbers, green beans, eggplant, many varieties of peppers, winter squash, pumpkins, and sweet corn; a processing kitchen was completed at the Farm, with stainless countertops, stove, three-basin sink, refrigerator, and freezer; the kitchen has been inspected by the county health department and used by local farmers for washing and staging delivery of specialty crops and for value-added processing of exempt products (jams/jellies); the walk-in coolers that were part of the renovation have been used by producers to stage delivery of bulk lots of specialty crops to local retailers and as a drop-off/pick-up point for an independently-organized local food buying club.
- Project personnel have partnered with other organizations on multiple activities oriented toward local food awareness, including six "local foods dinners", the Communiversity on-campus community garden, the Green Thumb Project and its work at the Ray Miller Elementary School Garden, organizing local producers to apply for a USDA-Rural Business Enterprise Grant to enhance local food infrastructure, providing an intern to coordinate community gardening activities at the Jameson Street Garden site (partnering with Northeast Missouri Community Action Agency); and working with local partners to plan a Community Food Projects grant proposal for the FY2014 period.
- Thirty-three college students from a variety of majors have had sustained, meaningful experience in specialty crop production that they otherwise would not have had due to activities associated with this project. The range of activities varies and is detailed as follows (some of the 33 students were involved multiple times in different capacities over the life of the

project and are thus represented in more than one of the following categories): 4 students had extended employment (three months to one year) with the food service contractor to provide local food coordination services, which included hands-on specialty crop production and supervising interns and other students specialty crop production, handling, and marketing; 7 students had season-long (10-week plus) internships in specialty crop production at the University Farm or local community gardening projects; 24 students worked for shorter durations (three to eight weeks at three to five hours per week) to assist with weeding, harvesting, and marketing specialty crops at an on-campus farmer's market. One of the students involved went on to manage a youth gardening project for a Kansas City non-profit; one student is employed as a farm manager at a produce operation in Colorado; and a third student is in the planning stages of beginning his own direct-market farm operation.

- One local producer has built a small produce wholesale business through relationships built as a result of this project. He has been handling an estimated \$10,000 in produce annually during the life of this project.
- A new farmer's market was developed as a result of this project. The "Market on the Mall" is an on-campus farmer's market at Truman State University that operates one day per week from August through October. It is estimated that just short of \$14,000 in specialty crops have been marketed through this venue from the market's inception in 2011 through the 2013 season.
- The University Farm Manager and student interns have attended workshops on GAP certification and visited GAP-certified produce operations in Iowa as part of planning to develop GAP/GHP certification for at least some of the crops produced at the University Farm (especially potatoes and tomatoes). The University plans to use the lessons learned through this effort to help other local, interested growers work through the GAP certification process for their own operations. As a first step, a group of students (including two that worked as specialty crop interns through this project) is planning a GAP workshop for February 2014 as part of their major capstone project (completed in the classes Agricultural Practicum I and II).
- A regional specialty crop logo (NEMO Just Picked) was developed through this project and is available for use of local specialty crop producers in marketing regionally-identified produce (see Figure 1).



Figure 1. NEMO Just Picked Local Foods Logo

Some of the project partners and the relationships cultivated with them through the life of the project are briefly summarized below:

- University of Missouri Extension personnel (especially regional horticulture specialist Jennifer Schutter) have worked with project personnel on multiple activities, including the January 2011 farm to school workshop and planning for the upcoming GAP workshop.

- Missouri Council for Activity & Nutrition helped with planning the 2011 farm to school workshop.
- Specialty crop interns have worked with a wide variety of other campus and community organizations to provide information about the health and environmental benefits of fresh, locally-produced fruits and vegetables. These groups include Staff Development Council, Environmental Campus Organization, Greater Missouri Leadership Challenge (women's leadership development conference; interns have presented a farm-to-school overview for the group for the last two years), Joseph Baldwin Academy (scholastic academy held at Truman for 7th-9th graders), and the Communiversity Garden.
- USDA Rural Development personnel attended the Farm to School Workshop and encouraged project personnel to apply for Rural Business Enterprise Grant funds to further enhance local foods infrastructure; project personnel are still attempting to organize local producers into a non-profit entity that would be eligible to apply for RBEG funds.
- The Green Thumb Project (local non-profit that sponsors school and community gardening activities) has partnered with project personnel on a wide variety of activities, including community garden projects and local foods dinners (the Fall 2012 campus local foods dinner had attendance of 300). Currently the grant coordinator is working with the director of the Green Thumb and a VISTA member working with Green Thumb to explore a Community Food Projects grant proposal that would focus on conducting cooking classes and nutrition education to increase utilization of local, seasonal produce in northeast Missouri. Additional partners would be involved in that project, including the Health Science students and faculty from Truman and the Kirksville Housing Authority.
- The Northeast Missouri Community Action Agency (NMCAA) has been a partner on the Jameson Street Garden, at which interns from this project helped tend a community garden site. The Kirksville Master Gardeners organization was another partner on this project.

Goals & Outcomes Achieved

Goal 1

Truman State University's food service will increase by 400% its purchase of fruits and vegetables produced within 100 miles of campus through this project. (GOAL)

This goal was partially met. The project proposal indicated a baseline value of \$8,000 spent by campus dining services on local fruits and vegetables during the 2009/10 academic year. This turned out to be an overstatement of the actual baseline value, as the food service assistant director was including a broad range of purchases in her "local" total, beyond just specialty crops. Using the invoice data that we were able to obtain from the food service contractor, we treated calendar year 2010 as the baseline year and estimated specialty crop purchases at \$1,500. The remainder of the estimated \$8,000 in local food purchases we divided into locally-produced honey, meat, dairy, and eggs (honey/meat/dairy) and processed foods purchased from local manufacturers (primarily salad dressing and croutons). (The specialty crop estimate may be slightly high, as the actual fruit and vegetable invoices totaled only \$921, but we did not have a complete invoice set.) We then tracked local purchasing in each of the three categories for calendar years 2011, 2012, and 2013 (to-date), as presented in Table 1. Using the Specialty Crop category only, local purchases as compared to the baseline year saw increases of 490%, 328%, and 334% for 2011, 2012, and 2013 respectively.

Table 1: Local Food Purchasing by Truman Food Service

Summary of Local Purchasing by Truman State University Food Service				
	Category			
Year	Specialty Crop	Honey/ Meat/Dairy	Processed Foods	Total
2010*	\$ 1,500	\$ 3,250	\$ 3,250	\$ 8,000
2011	\$ 8,853	\$ 5,086	\$ 5,922	\$ 19,861
2012	\$ 6,415	\$ 5,901	\$ 6,456	\$ 18,772
2013	\$ 6,505	\$ 7,232	\$ 13,235	\$ 26,971
*2010 data estimated based on statement from Food Service assistant director; only \$921 in receipts for specialty crop purchases actually documented				

Goal 2

The number of farmers from the nine county area producing fruits and vegetables for sale to Truman State University food service will increase as a result of this project. (GOAL)

This goal was met. Through the activities of the grant, six new producers in 2011 and five additional producers in 2012 had the opportunity to sell products to campus food service contractor (Sodexo) and/or to Truman students and staff via the Market on the Mall (project target was five per year). Five of these producers continued in this role during 2013.

Goal 3

At least two undergraduate students will gain first-hand knowledge of specialty crop production, regulatory issues, food safety, processing and handling procedures, and market development strategies for local foods as a result of this project. (GOAL)

This goal was exceeded. During the baseline year no Truman students completed internships in or related to specialty crop production. Through the activities of this project a significant number of students gained first-hand experience with specialty crop production. Six students completed 10-week mentored specialty crop internships during the years 2011 through 2013. One additional student completed a season-long internship with a local community garden project. Four students (or recent graduates) were employed by the food service contractor related to provision of local foods coordination services for the grant. Twenty-four additional students worked on an hourly basis during peak production periods and assisting with marketing of specialty crops via the on-campus farmer's market.

Goal 4

Students and staff at Truman State University will increase their awareness of what specialty crops can be produced locally and will have positive appraisal of produce quality. (GOAL)

Student and staff awareness of and appreciation for fresh, local fruits and vegetables were enhanced in numerous ways through this project. Student interns worked with campus food services to design and promulgate posters and table tents advertising the farm of origin for various local fruits and vegetables. Signage and promotional materials were included for food items in both residence hall dining facilities and at the "food court" in the Student Union Building, a combination that should reach 90% of students, faculty, and staff over the course of a typical semester. Student interns hired through the project started the first on-campus farmer's market in 2011 and continued it through 2012

and 2013. Produce from the University Farm and other local farms was sold on campus on Wednesday afternoons (so as to minimize competition with the Saturday morning market held on the Downtown Square). The students and other vendors received many compliments on the quality of the produce and appreciation from customers that it helped them get through the week until the Saturday morning market. A summary of produce sales for the August-October market period for each of the last three years is provided in Table 2.

Table 2: Sales of Local Produce at On-Campus Farmer's Market

Sales of Local Produce			
At On-Campus Farmer's Market			
Year	Univ. Farm	Other Vendors (est.)	Total
2010	\$ -	\$ -	\$ -
2011	\$ 2,647	\$ 2,000	\$ 4,646.87
2012	\$ 4,040	\$ 2,000	\$ 6,039.54
2013	\$ 2,270	\$ 1,000	\$ 3,270.21

As indicators of increased awareness of the availability of local specialty crops, the students had over 150 individuals sign a petition of support for their efforts (directed to campus administrators to encouraged continued University support for farm-to-school programming) during the 2012 market season and received over 50 letters and statements of support via social media. Excerpts from two such letters are copied below:

1) "I want to make my voice heard in support of the Farm to School Program. I have eaten your local produce many times in the Residence Halls for lunch as my husband and I both work at Truman. I especially have loved and appreciated the Market on the Mall. It is difficult to find really good produce and especially organic or mostly-organically grown produce. Besides being healthier, it actually tastes better, too. My 9-year old daughter learned to eat several new vegetables this summer that I purchased from Market on the Mall. My husband and I had veggies all summer long in the refrigerator from Market on the Mall. I even bought produce from Market on the Mall for my elderly grandmother and an elderly woman at church who cannot get out much. They enjoyed the produce so much and talked about how it tasted just like what they had on the farm growing up. Please let Truman administrators know how much we value the Farm to School Program. I know every time I was purchasing produce there were always multiple people at the Market on the Mall produce stand. I whole-hearted support the Farm to School Program. I know that Truman values and supports wellness programs, and as far as supporting wellness for the campus (students/faculty/staff) and the community, this program just can't hardly be beat!"

2) "I write to support the project several agricultural science students have conducted the last two years that has resulted in fresh produce available at Market On The Mall. While Truman students accomplish many commendable things, I think this project is the finest I have witnessed during my long career at the university. The students involved have recognized what a marvelous resource the university farm provides and the obvious sensibility of using the farm to produce food for the campus community.

I am always struck by produce grown in Peru or Chile or South Africa appearing at the local super markets and priced substantially below produce from our own country, despite the cost of transport half way around the world. Having seen how oranges are grown in South Africa without regard for worker safety, environmental contamination, or fair compensation for the

people doing the difficult and dangerous tasks, I deeply appreciate the opportunity to obtain locally and safely produced food at a reasonable price. Not to mention a supply line of but 1.5 miles.

I hope the university recognizes the wisdom of investing in this activity so it becomes a regular and even more significant contributor to the food requirements of our campus community."

Beneficiaries

Beneficiaries of this project's activities include the 33 students that received direct-experience in specialty crop production, 5,760 members of the campus community (90% of total population) that enjoyed increased access to fresh, local fruits and vegetables through campus dining services and/or the Market on the Mall, Missouri specialty crop producers that benefitted from increased access to the Truman institutional food service market (11 new direct sellers plus others who indirect beneficiaries of food service purchases made from one of the three new Missouri/regional wholesalers that they made contact with as a result of the grant), local producers who may benefit from improved local food infrastructure and knowledge (access to produce washing/storage facilities at the University Farm, involvement with the USDA RBEG grant effort, participation in the planned GAP workshop during February 2014), and other members of the northeast Missouri community who have benefitted from community outreach supported by the project (school garden collaborations with the Green Thumb Project, planned collaboration with Kirksville Housing Authority on Community Food Projects grant, local foods dinners [Fall 2011 campus dinner had attendance of 150; Fall 2012 dinner had attendance of 300; two off-campus fund-raising dinners held by the Green Thumb project have each had attendance of approximately 125]).

Lessons Learned

Many lessons were learned through completion of this project. Key lessons are outlined below:

- There is active interest in local foods and specialty crops in northeast Missouri, from both farmers and consumers. While there are significant challenges to market development, future efforts at cultivating market relationships should be effective. Through this project, the Truman State University Agricultural Science department and University Farm developed or strengthened partnerships with Sodexo, University of Missouri Extension, the Green Thumb Project, the Missouri Council for Activity & Nutrition, the Adair County Health Department, the Northeast Missouri Community Action Agency, USDA Rural Development (Adair County), and many independent specialty crop producers.
- Project personnel learned that there is significant latent production potential for fruits and vegetables in northeast Missouri. Through the farm to school workshop held as part of the project and via outreach efforts through independent local food wholesalers, growers (particularly members of local Amish communities) committed significant additional acreage to specialty crop production. In fact, when anticipated market opportunities with a Missouri-products wholesaler did not develop, local production capacity exceeded available demand; a lesson learned was that market development needs to proceed carefully, with an eye to matching planted acreage with anticipated demand—develop assurance of market access first, and the needed supply will emerge.
- Handling and distribution capacity is still a critical need. While the developments at the University Farm (in terms of vegetable washing and short-term storage/staging capacity) have been helpful for encouraging development of this nascent market, the University is unwilling to commit to use of these facilities as a medium- or full-scale "food hub". The nearest produce wholesale auction (Drakesville, IA) has generally not been a lucrative market for local growers. Producers sometimes obtain good prices there with early season produce but in peak growing

season supply overwhelms the available buyers. There seems to be opportunity for a for-profit regional food wholesaler to enter the northeast Missouri fruit and vegetable market, but initial efforts have been unsuccessful. A regional distributor from central Missouri made inquiries with local growers in early 2011, but didn't find adequate demand for product from northeast Missouri retailers and cut off ties with local growers as well. Ole Tyme produce made inquiries with some northeast Missouri growers, but they require GAP certification and local growers have so far been unwilling to take this step. The Truman Ag program plans to continue to work with local growers on GAP certification and thus increase the opportunity for these growers to connect with wholesalers who could handle the output of growers looking to expand into commercial specialty crop production.

- Project personnel gained greater awareness of the challenges of specialty crop production in northeast Missouri. There is generally a higher level of production risk associated with fruit and vegetable production in northeast Missouri as compared to the grain, oilseed, or forage crops that these specialty crops would be replacing. Two of the three growing seasons during the project period were particularly challenging, especially the 2012 drought year. The University Farm was able to utilize irrigation for key crops but other producers were not equipped with irrigation systems and production suffered considerably.
- Personnel also gained awareness of the particular challenges of marketing specialty crops to an institutional food service market. Institutional food service providers face particular challenges in their use of local, specialty crops that may require producers to market to them differently than to restaurants or to consumers via direct sale (farmer's markets, CSAs, etc.).
 - While institutional food service vendors are price-conscious (particularly in this case, as Truman is a public university with an all-you-can eat meal plan dining system), those growers selling to Sodexo during the project period actually found the prices quite attractive. This is partly because Sodexo was paying the same price to the growers as they would have paid to their wholesale vendor for the same product, so the producer was receiving the wholesale price plus the wholesale-food service margin. While this may not be attainable in all cases, if farmers can organize their own farmer-owned wholesale distribution entity, thus continuing to capture the wholesale-food service margin while centralizing invoicing and delivery for the convenience of the buyer, profitable opportunities for specialty crop production and marketing to institutional food service outlets may exist.
 - The seasonality of demand for campus dining services is a significant obstacle to specialty crop production and marketing in northeast Missouri. During May, June, July, and the first half of August, campus dining's purchases are only about one-tenth of what they are during the fall and spring semesters. This means that a peak portion of the typical fruit and vegetable harvest season occurs during a period when campus dining does not have a large need for product. Thus, growers either delay planting, (and in the process may reduce total output potential) or need to find alternative outlets for produce until the fall semester begins. Efforts to find alternative markets of sufficient volume were unsatisfactory during the project period. One local independent wholesaler worked to develop markets with a local retailer (Kirksville Hy-Vee) and moved some produce to farmer's markets in the St. Louis area; these efforts were partially successful, but additional market development is needed to build a sizeable and sustained specialty crop production base.
 - Perhaps the greatest obstacle to development of institutional food service markets as profitable outlets for local, specialty crop production is the pressure on these food service providers to economize on kitchen labor and culinary skill. The University Farm and other local growers attempted to target specialty crops that had greater storage potential and thus could be marketed throughout the fall and winter periods when student populations and food service demands were at their highest (two examples

were storage onions and winter squash). Unfortunately, growers found that the food service was willing to purchase limited (winter squash) or no (onions) quantities of these items because they require more knife work and prep time in the kitchen and both products can be purchased relatively cheaply in ready-to-use forms from institutional food service wholesalers. In other cases, food service specifications were relatively tight as to variety and size/grade of produce that they were willing to utilize. One example is tomatoes, where the purchasing manager wished to buy grape tomatoes for the salad bar (the most labor-intensive type for growers) but showed only limited desire to purchase slicers and no demand for any heirloom or “non-typical” varieties. Over the three growing seasons encompassed by the project, the staple specialty crops that growers knew they could grow and have predictable demand for from campus dining services were potatoes (size B “new” potatoes), tomatoes (especially grape and/or small cherry tomatoes), and melons. Other crops were demanded but at lower volume (summer squash, cucumbers, peppers—especially specialty colored bell peppers, winter squash, spinach, specialty greens, sweet corn).

Contact Person

Michael Seipel
660-785-4316
mseipel@truman.edu

Project 6: Vegetable Training and Education Garden

Mineral Area College

Chad Follis
Final Performance Report

Project Summary

The project purpose for the Agriculture and Horticulture Departments of Mineral Area College was to provide a sustainable agriculture vegetable growing training and educational garden. Community gardens have become vital fixtures in neighborhoods across the country and have many benefits, including education through knowledge of gardening, cooking, nutrition and health; helping the environment by increasing biodiversity, reducing fossil fuels, reducing rain runoff, and recycling. This educational site will allow agribusiness and horticulture students unique opportunities in both business and practical experiences.

Students were involved in the decision making process regarding the multiple aspects of gardening which includes selection of seeds and seedlings, planting, managing, harvesting and marketing of garden produce. The training and educational garden plots allowed the students and the community an opportunity to learn how to grow plants and seeds for food, flowers and aesthetics. This garden will allow students and the community to understand, in a larger context, the major implications associated with growing one’s own food and how high tunnel houses can extend the growing season. The garden can be expanded to include fruit and nut trees, grape vines and other specialty crops such as brambles, culinary and medicinal herbs, and cut flowers.

Project Approach

Students began growing summer annual vegetables in the HRT 1070 Plant Propagation and HRT 2540 Special Problems courses in February for planting in the garden the following summer. This was a wonderful addition to the horticulture curriculum and also a learning opportunity for most of the students who had never started summer vegetables before. Plot construction began in March with assistance from Mineral Area College (MAC) campus maintenance. Due to extreme amounts of rain (20") in March – late May not all of the raised beds were set into place until early June. The rain made delivery and mixing of the soil/compost mixture impossible. The soil media arrived on June 6, 2011 and was immediately moved into the raised beds.

Upon soil filling, beds were planted with the hardened off summer vegetables grown by students. All beds were planted by the end of June. July weather was the opposite of March – May, with limited rainfall and extreme high temperatures. Plants began to produce harvestable vegetables and these were sold on campus by the garden intern. A total of \$164 was made over the summer from sales of garden vegetables. The weather was a major limiting factor along with theft. Two additional measures that limited the 2011 income were that the hoop house could not be constructed in time for winter 2010 crops and some of the summer crops such as pumpkins and watermelons never fully matured due to the late planting date. There were numerous times where near harvestable plants were missing on Friday, which was harvest and sales day. This necessitated the installation of a chain link fence around the garden.

Summer Crops Grown: tomatoes, squash, cucumber, okra, pumpkin, cantaloupe, watermelon, eggplant, bell peppers, basil, thyme, dill, cilantro, parsley, lavender, oregano, mint, chives, strawberries and sweet potatoes.

Once classes began again in the fall, students cleaned the garden of all summer crops which were beginning to show signs of distress and limited production due to their lifecycles ending. The summer vegetables were replaced with cool-season crops and each student was assigned a bed to care for from September until the semester ends in December. Students participated in an experiment where half of the raised beds were covered and half were not. The objective is to illustrate how row covers can be used to extend the growing season later into the fall. The other major event in the garden over the fall was the final construction and installation of the hoop house. This event took place over several days with the help of campus maintenance. Soil is being prepared currently to begin seeding cold weather crops for season long growing. Part of the construction of the hoop house required some deep tillage and leveling which was completed prior to construction and seeding.

Fall Crops Grown: leaf lettuce, head lettuce, romaine lettuce, spinach, swiss chard, broccoli, cauliflower, brussel sprouts, beets, carrots, and parsley.

Goals & Outcomes Achieved

Outcome #1: Increased Enrollment of 10% - This outcome was met with a 71% increase in enrollment after the garden grant was received. Prior to the grant a total of 31 students were enrolled in courses that would be impacted by the garden and 53 students were enrolled in the same courses after the garden grant was awarded.

Outcome #2: Sell Vegetables, with goal of \$1,000 – \$1,073 dollars raised during the granting period from sales of vegetables and vegetable plants. These plants/vegetables were grown and raised by the students from measurable outcome #1. Three donations were also given from the MAC garden over the granting period to the local food pantry. Once the summer semester was completed the sale of produce was limited so the produce from this down period was donated at a value of \$250. Additionally, the extra plants that were grown in course labs were sold in the spring with non-sold plant donated to the pantry as well at a value of \$162. Including both the real dollars and donation the total increases to \$1,548.

Outcome #3: Community Outreach, 200 attendees – Outcome number three was met with 455 total persons visiting the garden during the granting period. The attendees were from various groups such as the local master gardeners, garden clubs, students, retired teachers, and FFA members. The garden was also promoted on 4 local radio spots, 3 donations to the local food pantries, 1 MAC alumni magazine profile and numerous sales exchanges. The garden is signed by a campus secondary entrance with 200+ students parking in daily view of the garden and visible signage.

Outcome #4: Partner with local farmers markets – This outcome was met but in a different manner than originally submitted. With too much rain one season (2011) and too little rain (2012) the next season a specific day to have a farmer's market field day did not become available. We decided to partner with the local Master Gardeners chapter and present at their annual winter conference on vegetable gardening and season extension growing techniques. Surveys were made available to attendees to provide feedback which will be covered in Outcome #5. The project received three letters of support for Outcome #4 from the Chair of the local farmer's market, a farmer's market member who is using principles from our garden, and the President of the local Master Gardeners.

Outcome #5: Increased Knowledge – The results of the survey showed that 34 of 41 respondents garden using vegetables and the experience of these gardeners was split close to evenly between novice (18) and avid (22). Tomatoes are the most common plant started indoors with 2/3 of respondents vegetable gardening in the spring and summer months. This appears to leave a space for increased education about fall season extension gardening techniques which this grant worked toward. Questions 6-8 reinforced this idea with only 6 of 41 respondents saying they currently use season extension techniques, 39 of 41 willing to use season extension techniques and 40 of 41 wishing to learn more about season extension gardening.

Half of respondents that have tried season extension tried to grow lettuce. When asked about the pest control methods 9 of 41 responses were "organic", 11 of 41 were "traditional" meaning use of pesticides and 15 responses were "both". "Both" were interpreted to mean that the individuals use organic techniques but will insert traditional methods as a last resort of control.

The 11th question asked if the respondents learned something new from the MAC training garden and a very strong 39/41 responded yes. When asked how they planned to alter their gardening techniques 31/41 responses focused on season extension techniques, cold frames, hoop-houses or row covers. The remaining 10 discussed soil amendments and pest control measures. It could be assumed that by altering gardening techniques the garden would be easier to care for and 33/41 respondents felt that learning at the MAC vegetable garden would make their garden easier to care for. Only three individuals felt their garden would not be easier to care for and two folks were undecided. In keeping with the easier to care theme 31/41 folks felt that gardening in the future would be less stressful than prior to the MAC gardening class and half the surveys showed that folks planned to grow a vegetable garden in the future.

When asked about soil amendments 34/41 planned to make soil amendments in the future 38 saying the amendment would be compost. To complete the survey respondents were asked if they would like more course/classes on vegetable gardening offered at MAC and 38/41 said yes. This is very positive sign and a good indicator that this grant was well timed and the community is in need of proven vegetable gardening and season extension information.

Question 19 was open for individuals to explain why the MAC garden grant was beneficial to the community. These responses can be viewed in the spreadsheet titled Garden Spreadsheet included with this report.

Ancillary information: Further outline success of outcomes #4 & 5 - Since the installation of the garden, two students who worked as market gardeners have graduated. The two students are selling

at Farmington, Fredericktown, Perryville, Ste. Genevieve, Kirkwood, & Souland Farmers Markets. We have a student performing her summer internship at Crown Valley Organics which sells to the Kirkwood, Schlafly Bottleworks and Farmington Farmers Markets. We also have a student who has included vegetable garden design and installation into his landscape company to fill a missing need in the market. Without this grant, the introduction of vegetable gardening would not have been possible to the degree the Mineral Area College was able to integrate this renewed area of horticulture.

ID	1 Gardened using veg?	2 Experience	3 Started plants	4 what plants	5 spring summer or fall	6 season extension technique	7 willing to use season extension	8 learn about season extension	9 Did you grow a crop?	10 tradition or organic	11 learn new?	12 after garden maintenance
18	Y	Novice	N		All 3	N	Y	Y	Kale, carrots, peas, lettuce	Organic	Y	Compost
20	N	Novice	N		None	N	Y	Y	Lettuce	Neither	Y	
22	Y	Avid	Y	Tomatoes	Summer	N	Y	Y	Lettuce, beets	Both	Y	
23	Y	Novice	Y	Tomatoes	Summer	N	Y	Y	Lettuce, peas	Traditional	Y	Soil amendment
24	N	Novice	N		None	N	Y	Y	Mustard		Y	
25	Y	Avid	Y	Tomatoes, beans, broccoli, cauliflower	Summer	N	Y	Y		Organic	Y	
26	N	Novice	N		None	N	Y	Y	Lettuce	Neither	Y	
27	Y	Avid	N		Summer	N	Y	Y	radishes	Traditional	Y	Row covers
28	Y	Avid	Y	Tomatoes, peppers	All 3	Y	Y	Y		Both	Y	Season extension
29	Y	Avid	Y	Numerous	Spring & Summer	N	Y	Y		Both	Y	Season extension
30	Y	Avid	Y	Tomatoes, cucumbers, peppers	Spring & Summer	N	Y	Y	Brussel sprouts	Organic	Y	Season extension
31	Y	Avid	Y	Tomatoes	Summer	N	Y	Y	Broccoli	Organic	Y	Season extension, crop rotation
32	Y	Avid	Y	Numerous	All 3	Y	Y	Y		Both	Y	Season crops & proper planting times
33	Y	Avid	Y	Numerous	All 3	Y	Y	Y		Both	Y	Season extension
34	Y	Novice	Y		Summer	N	Y	Y	Peppers	Both	Y	Cold frames
35	Y	Avid	Y	Tomatoes, peppers, squash	All 3	N	Y	Y		Both	Y	cultivate area after harvest and replanting
36	Y	Avid	Y	Tomatoes, peppers, beans	All 3	N	Y	Y	Brussel sprouts	Traditional	Y	row covers & high tunnel
38	Y	Avid	N		All 3	N	Y	Y	Kale, carrots, peas	Organic	Y	Fertilizer, compost
39	Y	Avid	Y		Summer			Y	Okra	Both	Y	Right plant Right place
40	Y	Avid	Y		Summer	N			Grapelimes	Both	Y	Fertilizer practices
41	Y	Novice	N		All 3	N	Y	Y	Tomatoes	Organic	Y	Row covers
42	Y	Novice	N		Spring & Summer	N	Y	Y		Traditional	Y	
43	Y	Novice	Y	Tomatoes	All 3	N	Y	Y		Traditional	N	
44	N	Novice	N		Spring & Summer	N	Y	Y	Tomatoes, squash, herbs	Traditional	Y	Insect and disease

10	13. explain to grow a veg garden?	14. will you stress full?	15. has 1/1 cult	16. can post?	17. 19. 44. Cms, 27.0m	20. Additional course
18	Y	Y	Y	Y	Yes it does, it offers where students learn and applies it to their knowledge. They have the chance to grow their own gardens and spread it out through the community.	Y
20	Y	Y	Y	Y	Yes because it is important to be able to produce your own crops. Especially with the rate our population is supposed to grow	Y
22	N	N	Y	Y	Yes the vegetables go to our canteen and the garden gives a peaceful environment to go to on campus	Y
23	Y	Y	Y	Y	Yes	Y
24	Y	N	Y	Y	Yes it brings people together that normally wouldn't meet as well as learn something new	Y
25						
26	Y	Y	Y	Y	Because it is cheaper but it takes longer to grow than to buy	Y
27	Y	Y	Y	Y	I think it is good to allow people how to grow your garden instead of buying everything from the store	Y
28	Y	N	Y	Y	Yes I find it beneficial because people need to be exposed not to just general gardening methods but also new methods	Y
29	Y	N	Y	Y	Yes it teaches the practicality of good gardening practices and the value in teaching to others in the community who may not have been aware	Y
30	Y	Y	Y	Y	Yes I think it will encourage students to grow their own food	Y
31	Y	Y	Y	Y	Locally grown food is a very positive thing for the community	Y
32	Y		Y	Y	Yes it is very important that more people understand the importance of growing your own food	Y
33	Y	Y	Y	Y	Yes it is good to educate people, especially the next generation	Y
34	Y	Y	Y	Y	The plant sales and helping towns	Y
35	Y	Y	Y	Y	Yes it shows people that not only is it healthier to grow & eat your own vegetables, but that no matter how big or small your yard, you can have a vegetable garden	Y
36	Y	Y	Y	Y	Yes it will benefit me and my family bc it has given me a better understanding of gardening. It benefits the community bc I plan to start selling fresh produce locally	Y
38	Y	Y	Y	Y	It offers what students learn and applies it to their knowledge. They have a chance to grow their own gardens and spread it through the community by sale or by other means	Y
39	Y	Y	N	Y	Everyone should know how to grow even if they don't use it	Y
40	Y	Y	N	Y	Yes everyone should have knowledge about growing vegetables, own to manage soil and use of pesticides	Y
42	Y	Y	Y	Y	Education increases movement and hopefully people are educated and concerned, then maybe they will take an interest in their world, food and environment	Y
43	Y	Y	Y	Y	It was an excellent opportunity for the college community to see what horticulture does for the community	Y
44	Y	Y	Y	Y	I could live off my gardening skills	Y

10. Gardened using veg?	1	2. Experience	3. Started plants	4. what plants	5. spring summer or fall	6. season extension technique	7. willing to use season extension	8. learn about season extension	9. Did you grow a crop?	10. traditional or organic	11. learn new?	12. after garden maintenance
45	Y	Avid	N		All 3	N	Y	Y	Broccoli Sprouts, Broccoli	Both	Y	
46	Y	Avid	Y	Tomatoes, peppers	Spring	N	Y	Y		Traditional	Y	cover crops, hoop house, mulch
47	Y	Novice	Y	tomatoes	All 3	N	Y	Y	N	Organic	Y	raised beds, hoop house
48	Y	Avid	N		Spring & Summer	N	Y	Y	lettuce	Both	Y	pesticides, mulch, compost
49	Y	Novice	Y	tomatoes	Spring & Summer	N	Y	Y	N	Traditional	Y	raised beds
50	Y	Avid	Y	vegetables	All 3	N	Y	Y	cole crops	both	Y	Mist system, hoop house, cold frames
51	N	Novice	Y	tomatoes, basil, broccoli	Summer	N	Y	Y	N	Traditional	Y	composting, crop rotation
52	Y	Novice	Y	Peppers, tomatoes	Spring & Summer	N	Y	Y	Y	Traditional	Y	watering techniques
53	Y	Novice	N		Spring & Summer	N	Y	Y	N	Traditional	Y	adjusting harvest times
54	Y	Avid	Y	tomatoes, herbs	None	N	Y	Y	Y	Organic	Y	hoophouse, row covers
55	N	Novice	N			N	Y	Y			Y	if garden then yes
56	Y	Novice	Y	Dill, cilantro, squash	All 3	Y	Y	Y	Grapes, kale, raspberries	Both	Y	More raised beds with window on top to act as greenhouse (cold frame)
57	Y	Avid	Y	veges, herbs	All 3	Y	Y	Y		Organic	Y	more compost bins
58	N	Novice	Y		None	Y	Y	Y		Both	Y	row covers
59	Y	Novice	N		Summer	N	Y			Traditional	Y	more organic techniques
60	Y	Avid	N		Spring & Summer	N	N	Y		Both	Y	Row covers

ID	13 easier to care?	14 will you grow a veg garden?	15 less stressful?	17 soil?	18 com-post?	19 MAC veg garden	20 Additional courses
45	Y	Y	Y	Y	Y	I gained additional personal knowledge regarding how to increase the amount and types of vegetables I grow. The course is valuable to the community to share knowledge	Y
46	Y		Y	Y	Y	Increased information confidence and skill	Y
47	Y		Y	N	Y	helps resolve issues you are experiencing. Helps you to not get frustrated and give up	Y
48	N	Y	Y	Y	Y	Y	Y
49	Y		Y	Y	Y	The workshop cover a wide variety of topics and each is very helpful. New techniques and ways to do things.	Y
50	Y		Y	Y	Y	Yes it is a learning tool and helpful to beginners as well as professional	Y
51	Y	Y	Y	Y	Y	MAC is indispensable to my family. I will grow extra food for the food pantry and I wish more people in need had programs like this one to help provide for their family.	Y
52	Y	Y	Y	Y	Y	Its allowed me to have a more productive season and have a easier season	Y
53	Y	Y	Y	Y	Y	this is interesting, inspiring and very worth while	Y
54	Y				Y	It is great to be able to see a hoop house and greenhouse in operation to see the possibilities	Y
55	Y	Y	Y	Y	Y	Very helpful for young people that don't garden much	Y
56	undecided	Y	Y	Y	Y	Any education is good	Y
57	probably	Y	hopefully	Y	Y	Absolutely, any promotion of gardening is valuable to our society	Y
58	Y	Y	Y	Y	Y	Great resource and has given a great diversity of educational tools	Y
59	Not necessary		Y	Y	Y	Absolutely great way to increase knowledge and gather info on other gardens	Y
60	N	Y	N	Maybe	Y		Y

Beneficiaries

Direct beneficiaries of this project would be the 40 students each school year who take courses in the MAC Agri-business department. Sellable produce would be available for sale to a campus community with roughly 3,000 students, faculty and staff on the main campus where this project will be carried out. Two local FFA chapters have started “community gardens” with the help of East Missouri Action Agency in the college’s service district. These students and instructors would be potential beneficiaries by the sharing of techniques, education and field day attendance. Final numbers are not available for FFA participation since the public school year is not in-session at the time of this submission. Estimation of these numbers will be 25. Additional groups would be the five local garden clubs each with approximately 30 members and the local University of Missouri Extension Master Gardeners with 20 active members on the roster. Field days would involve the local Farmers Market which has 30 members. Hopefully, 150-200 individuals will be impacted directly through field days, classes and outreach projects each year with more indirectly through purchase of produce.

The MAC horticulture program is also the beneficiary of numerous gifts related to the Vegetable Training Garden in 2011. The first was an expansive hydroponics growing kit. This has been integrated into the training garden to illustrate how vegetables can be grown hydroponically in limited space. A local winery donated grape vines for propagation purposes so now the garden has six trellised grape vines and a local nurseryman donated four blueberry bushes which are planted in the garden. A separate individual donated two blackberry bushes and two raspberry bushes that are also trellised and producing fruit. The growing bags mentioned earlier were also donated. All of these donations have been used to enhance the project and hopefully reach a broader audience. Donations were accepted, but were unsolicited and un-requested by the MAC horticulture program.

Lessons Learned

One pesticide application was required in July to control Japanese Beetles. This application was targeted at the height of the outbreak to control the most pests and reduce insect numbers to manageable levels. Pest control was done following IPM procedures with most pests controlled by mechanical measures thus furthering the sustainability measures of the garden. All weeds were hand pulled or cultivated to control populations. Watering was done early in the morning to limit the amount of leaf wetness thus reducing disease infection.

The June 8, 2011 field day was rescheduled for fall due to spring and summer weather pushing plot construction back to June 6, 2011. A fall field day was proposed but a date that worked for MAC, University of Missouri Extension and potential speakers could not be isolated. A discussion took place to determine a date for 2012. The project was discussed and visited during the Mineral Area Master Gardeners in March of 2011. Thirty individuals attended. Eleven students worked on growing the summer crops in the two campus horticulture courses. The Mineral Area Master Gardeners fall training course visited the garden and campus greenhouses, with 20 attendees. Currently, 24 students have spent time in the garden this semester. We were invited to present at the 2012 Mineral Area Master Gardeners conference to cover season extension methods. Each session is scheduled to have 30 attendees. The garden is intentionally situated by the rear primary campus entrance. This entrance is adjacent to a 200+ parking lot. This is a large amount of daily visibility to the project and Missouri Department of Agriculture. Finally, two radio spots highlighting the MAC horticulture program gave a large amount of exposure to the garden training garden. Both programs aired in June. Another area of exposure to this project is the Friday sales. Attendance was not counted during the sales.

Total Attendance for 2011:

Master Gardeners Conference	30
Spring Courses	11

Master Gardeners Training	20
Fall Students	24
Radio Spots	2
Friday Sales Events	Unknown

2012 Events (to date):

Master Gardeners Conference

The overall garden design was influenced by the European Potager Garden Design. This garden design calls for the combination growing of vegetables and ornamentals in the same space to allow for a beautiful plate of food and well decorated table. The garden has the following raised beds:

No.	Size	Material	Depth
3	4'x6'	landscape timber	8"
4	4'x6'	1"x6" lumber	12"
2	4'x4'	1"x6" lumber	12"
2	4'x4'	1"x6" lumber	6"
3	4'x4'	Block	8"
1	4'x4'	Block	16"
2	3'x3'	Lumber	8" – coldframes
2	4'x8'	Lexan	8" – coldframes
8	20 gallon	Fabric	2' – garden bags
1	18'x18' In-ground		6"

The diversity of beds allows for numerous different demonstration garden techniques and teaching opportunities. The 12" beds are built to illustrate designs for handicap individuals to reduce bending and stooping. The 6" and 8" beds give diversity to illustrate how certain crops such as carrots or potatoes need more growing room to fully develop. The bed depths also allows for discussion about water holding and nutrient capacity. The range of construction materials illustrates the range of production options and budgets. Additionally, longevity of construction materials is also of concern for beds permanence. The concrete block beds are a nice alternative to lumber in permanence and also should warm up faster in the spring and keep warmer later in the fall compared to the lumber materials, but are also more expensive. This illustrates that construction materials alone can alter management techniques. The row-covers are made of two different materials and are two different sizes again to illustrate diversity and show the functionality of season extension. Many times individuals feel like they cannot garden if they reside in an apartment when in fact it is the opposite. they can. The goal of using the garden grow bags is to show that even the most limiting space can produce locally grown vegetables. All raised beds are going to be compared to the traditional in-ground beds. Numerous experiments are going to be carried out over the course of the next three college semesters illustrating growing techniques compared to construction materials. One additional area of design for the training garden is the inclusion of a 15'x15' composting site in the garden. This will be the first composting site on the MAC campus.

Contact Person

Chad Follis
573-518-2323
cfollis@mineralarea.edu

Additional Information

Letters of Support:

Letter #1

As an organic market gardener, I want to take this opportunity to tell you how much I appreciate your work in creating the vegetable training garden at Mineral Area College. Because the Farmington Farmer's Market opens early in April, it used to be difficult for me to come up with products to offer for sale that early in the season, but your tours and classes involving the use of the hoophouse and season extension now enable me to have a greater variety of spring vegetables available for sale much earlier than I did in the past. (Some of my customers now call me weeks before the market opens, so that they can enjoy their first baby spinach salad while looking out the window at snow on the ground!)

Earlier this month, a new generation of gardeners gained a voice in the future of our farmer's market when we elected Devin Crocker, who is in his late teens, to our market Board. It is my belief that young people like Devin don't view sustainable systems as a drudgery, but rather as a sensible way to approach the environmental, economic, and social challenges that their generation has inherited, and programs like yours are the tools that they are using to create solutions to those challenges.

As a Master Gardener with a special interest in vegetables, I've been especially gratified that your vegetable classes are among the first to fill up at our annual Symposium. I've talked to folks at the Symposium who previously didn't have an interest in growing vegetables, but who are now inspired to tuck lettuce or broccoli or tomato plants into their flower beds after taking your classes!

Thank you, Chad, for making such a good resource available to our community. Your work in developing the vegetable training garden has helped home gardeners, market gardeners, and even folks who never thought about gardening before now to expand their options. You have planted the seeds of a stronger, more sustainable future for us all with this project.

Letter #2

The vegetable classes and handouts that you have used in the past several years have had a huge gain for the Farmington Farmers Market. Not only are the farmers more aware of the vegetables they grow; they also realize there are new ones to experiment with to see if the public is interested. The farmers are also more aware of the need to have their soil tested and amended if that is necessary. With your help and outreach they have learned more about pests and diseases that can attack their vegetables. They are less hesitant to talk to the public about their crops and are willing to share their vegetable knowledge with others.

Thank you for providing a menu of classes, and an opportunity to see a greenhouse and hoop house in action and how it benefits the grower. Your community commitment benefits everyone, because more people are growing gardens of their own and come to the Farmers Market on a regular basis for fresh produce.

Letter #3

As President of Parkland Master Gardeners, we have been able to see how instrumental the vegetable and hoop house gardens at Mineral Area College (MAC) have been to the community. Our Master Gardener (MG) group works closely with MAC to bring horticulture, permaculture, and agriculture education to the forefront of the community. From a personal and professional standpoint I can say that there has not been any more crucial time to have these gardens to use than now. The growing interest in growing one's own food is growing by leaps and bounds; however questions still remain in the public on how to implement it into their lives.

Each winter, our MG group holds a winter conference that we hold at MAC specifically due to the demand for the vegetable, greenhouse, and cold frame gardening classes we offer. Because these working demonstration gardens are there we are able to give hundreds of people who are eager to

learn these growing techniques, an incredible educational experience. In the last two years alone, we have offered these classes repetitively and our surveys show there is still an increasing demand for more of these hands on classes. Chad Follis has been instrumental in helping to teach these classes by not only teaching these classes, but also doing countless tours of all the greenhouses and hoop houses.

Parkland Master Gardeners already has classes full in summer at the demo gardens grounds where they will learn seed starting techniques, organic gardening, season extension techniques, non-traditional seasonal crops and overall vegetable gardening. These classes we offer are the first to fill up to capacity, demand increases each year and most likely will for years to come. As you can see, Mr. Chad Follis, MAC, and the grants for the gardens have been instrumental in bringing gardening education to hundreds, to those within a 150 mile range of the college.

I sincerely hope that this program will continue to grow to keep up with the demand of those interested in learning more about this important subject. There could not have been a better and easier place for us to teach these topics than at MAC with Chad Follis. His passion and gumption for horticulture, coupled with his hands on technique with the public and Parkland Master Gardeners are what have and will continue to make these vegetable gardens and hoop houses a success to our community and beyond.

Project 7: Advancement of American Elderberry as a Missouri Specialty Crop by Elucidating its Pest and Disease Complex

University of Missouri, Southwest Research Center

Andrew Thomas

Final Performance Report

Project Summary

The American elderberry, a native Missouri shrub, is an emerging and promising specialty crop for producers in Missouri and the Midwest. Both the fruit and flowers are used in wines, jellies, food colorants, and as dietary supplements. Numerous farmers are planting elderberries in Missouri in response to an increasing demand for American elderberry products; however such farmers are taking substantial risks due to the lack of sound research-based horticultural production information. In particular, the pest and disease complex of elderberry is largely unstudied and unknown, and this knowledge gap is one of the most important factors hindering the development of elderberry as a specialty crop. Specifically, microscopic Eriophyid mites and viruses are some of the most important pests of elderberry, and among the most difficult to study. Until now, we did not even know which species of mites or which viruses infest elderberry in Missouri; such information is critical to understanding these pests' life-cycles and how best to manage them in the orchard.

This project was extended for 9 months, through Sept. 30, 2013. While the majority of grant funds had been spent as originally proposed, we were frugal with funds and some remaining dollars were well-utilized during a third summer growing season to further expand and refine our results.

Project Approach

There were two major parts of this project: 1) Studying the identification, life cycle and potential control strategies for microscopic Eriophyid mites that infest elderberry, and 2) identification of viruses that infect elderberry and evaluating the possibility of developing virus-free plants.

Eriophyid Mites on Elderberry

Eriophyid mites on infested elderberry stems and leaves were sampled multiple times through-out the project (2011-2013), and evaluated microscopically. Our colleagues, Dr. Bill Reid (Kansas State University) and Dr. Michele Warmund (University of Missouri) assisted us throughout the project in microscopically studying the identities and life-cycle habits of these mites. Meanwhile, we initiated a field study on management of Eriophyid mites in elderberry. The study included established elderberry plantings at two Missouri sites (Mt. Vernon and Mountain Grove). Our approach was to apply treatments of horticultural oils (dormant oil and summer oil) and a conventional miticide (Agri-Mek) in various combinations to ascertain the effectiveness of each product alone or in combination.

Viruses in Elderberry

A variety of elderberry material was shipped from Missouri to Dr. Bob Martin, Plant Virologist at the USDA-ARS Horticultural Crops Research Unit in Corvallis, Oregon. In addition to live plants, both fresh and dried leaf materials were sent for evaluation. Double-stranded RNA extraction was carried out on all of these plant samples to screen for viruses, and several viruses were detected. We are still determining if some of these viruses are pathogenic and / or may hinder the potential productivity of elderberries. Additionally, a variety of efforts (such as heat treatment) were implemented to determine if virus-free elderberry plants could be produced.

Goals & Outcomes Achieved

Both Eriophyid mites and viruses that infest elderberry in Missouri were identified for the first time, which alone, is a very significant achievement. Finally knowing precisely what organisms we are dealing with opens doors to a tremendous amount of additional discovery about these pests and their management.

Eriophyid Mites on Elderberry

Dr. Warmund identified two different species of mites from different areas of Missouri, and with different damage patterns on elderberry plants. The mite *Phyllocoptes wisconsinensis* was previously reported as occurring on elderberry in other regions of North America, and is now confirmed in southwest Missouri. This mite causes the typical distortion of leaflet margins with occasional damage to flowers. A second species of mite appears to be new to science, which is an exciting discovery. This mite was found on elderberry in central Missouri, with damage manifested as reduced leaf size and inter-veinal puckering of leaflets. Dr. Warmund also studied overwintering mites, confirming their presence under bud scales on dormant above-ground stems.

The orchard management study of mites was fully implemented, but results were less than satisfactory because we did not have sufficient infestations of mites to fully evaluate our treatments. We used older plantings of elderberry at two locations. Because Eriophyid mites are extremely common in elderberry, and because we had previous mite infestations in the two plantings used, we assumed that these plantings were ideal for the study. However, naturally-occurring mite infestations were unusually low in both orchards, and simply not sufficient for us to satisfactorily evaluate our treatments at mite management. Unfortunately, we have no known way of inoculating our orchards with these microscopic mites in order to establish such a study if naturally-occurring mite populations are low. Nevertheless, we are continuing this portion of the study well beyond the scope of this grant; the grant has permitted us to set the stage for completion of this important work over the next few years, and we fully intend to do so.

Viruses in Elderberry

Double-stranded RNA (dsRNA) extracted from four elderberry cultivars showed the same dsRNA pattern, with multiple bands of about 8000 base pairs plus several smaller bands. The dsRNA from cultivar 'Bob Gordon' was used as a template for sequence and further analysis. DsRNA was converted to cDNA using reverse transcription, then amplified using PCR and subjected to High Throughput Sequencing. Approximately 75 million reads were obtained and assembled into contigs using SCRAPE software. Two large but distinct contigs of 8521 and 8425 were obtained, which showed significant levels of sequence identity to several carlaviruses and 51% nucleotide sequence identity between each other. From the nucleotide sequence data and translated amino acid data, it is clear that there are two distinct carlaviruses infecting elderberry and it appears that one is related to *American hop latent virus* and the other related to *Poplar mosaic virus*. Examination of the serological relationships of these viruses to *Elderberry latent virus* continues. Our USDA collaborators experimented with techniques to rid the elderberry plants of viruses, including heat treatment and meristem culture. They reported that obtaining a clean (aseptic) culture of elderberry shoots was difficult. Nevertheless, a small number of plants were obtained through meristem cultures that appear to be virus free. This is a significant achievement that establishes a foundation for future advances in developing and maintaining virus-free elderberry stocks.

We became very interested in whether or not we could detect viruses in dried leaf material rather than having to use fresh material. If dried material could be used, tremendous opportunities would become available for efficient elderberry virus research, including screening wild populations for viruses. Unfortunately, however, viruses were not easily isolated from dried leaf materials. This is important information and guides our efforts toward appropriate fresh materials for this research.

Beneficiaries

The immediate beneficiaries from this project are several hundred current and future elderberry producers, as well as the scientific community. Ultimately, thousands of elderberry consumers and processors will be impacted as higher-quality elderberries are produced in a more sustainable manner with improved pest management. Such detailed information discovered on elderberry pests may not be manifested in immediate improvements and increases in elderberry production and quality, but rather long-term, gradual improvement as producers understand and embrace this new information. These beneficiaries (including scientists) also benefit in that the stage has been set for the next level of research on these pests which will lead to higher quality elderberry production with less risk to producers. If virus-free elderberry plants can ultimately be developed (set in motion by this grant), the level of elderberry nursery production can be raised to the very high standards of virus-free nursery production established for other fruit crops such as strawberries and brambles.

Lessons Learned

During this project, we learned a tremendous amount about the mites and viruses that infest elderberry in Missouri. The incremental improvements in our understanding of the life-cycle habits of these mites, including their first-ever identification, is a rewarding accomplishment for our team. Likewise, the basic identification of viruses in Missouri-grown elderberries is a significant achievement that further sets the stage for even more significant answers about the identity, pathogenicity, and management of viruses in elderberry. The un-satisfactory results of our field mite-management study (due to lack of naturally-occurring mites) has taught us how challenging and unpredictable Mother Nature can be in any biological or agricultural system, and that we will need to broaden that portion of our study to incorporate more "opportunities" for mite infestation in order for us to accomplish our goal of determining how best to manage these important microscopic pests.

Contact Person

Andrew Thomas
417-466-0065
ThomasAL@missouri.edu

Additional Information

The following presentations were made at the First International Symposium on Elderberry, held in Columbia, Missouri, June, 2013. More than 80 people attended each of the presentations. Scientific, peer-reviewed papers with the same titles will be published in 2014 in a stand-alone volume of *Acta Horticulturae* resulting from the Symposium. These publications will summarize much of the work done under this project, and will be available on-line to all once they are published.

Keller, K.E., A.L. Thomas, D.F. Quito-Avila, and R.R. Martin. Identification of Two Carlaviruses in Elderberry.

Warmund, M.R. and J.W. Amrine. Characterization of Eriophyid Mites Inhabiting American Elderberry.

Project 8: Disinfestation of Asian Chestnut Gall Wasp Larvae from Chestnut Scion Wood to Produce a Clean Source of Nursery Stock

University of Missouri

Dr. Michele Warmund
Final Performance Report

Project Summary

Demand for chestnuts in the United States is currently being satisfied primarily by imported nuts. From 2000 to 2005, an average of 4500 tons of chestnuts was imported into the United States, and these nuts have historically come from Italy and China. However, in recent years, several different chestnut species and their hybrids have been planted and nuts from these trees have been marketed in the United States. Yields from chestnut trees grown in the U.S. range from 750 to 2,000 pounds/acre at a retail price of up to \$6/pound thus, profit potential for chestnut production is high.

Since 1995, the University of Missouri Center for Agroforestry (UMCA) has conducted research on chestnut as a specialty crop for Missouri and other parts of the U.S. to assist producers in cultivar selection, management practices, and marketing of chestnuts. During the 2009 growing season, UMCA conducted a series of educational workshops to assist 40 new growers in developing chestnut plantings for commercial production of fresh chestnuts. It is expected that 100 acres of chestnut trees will be planted in Missouri within the next two years.

Consumer surveys indicate a strong preference for locally grown chestnuts compared to imports. Producers indicate that demand exceeds the current level of production. With unmet demand for fresh chestnuts, there is potential for expanded chestnut production in Missouri and the United States.

The Asian gall wasp (*Dryocosmus kuriphilus* Yasumatsu) was introduced into North America in 1974 on imported chestnut cuttings. The wasp is a native of China, but is also considered a major pest in

Japan and Korea. Chestnut species affected by the gall wasp include *Castanea dentata* (American chestnut), *C. mollissima* (Chinese chestnut), *C. crenata* (Japanese chestnut), *C. sativa* (European chestnut) and *C. pumila* (chinquapin). The gall wasp has been identified in Georgia, Alabama, North Carolina, Virginia, Maryland, Pennsylvania, Maryland, Kentucky, Tennessee, and Ohio. While the gall wasp has not yet been found in Missouri, it is very likely to be imported into the state soon and be a major threat to nut production. The distribution of this pest in the United States is primarily due to the transport of infested seedlings to new areas and the exchange of infested scion wood used to graft new trees.

Female adult wasps lay eggs inside buds of chestnut shoots in early summer and eggs hatch in 40 days. Larvae remain dormant until the following spring. As bud growth begins, larvae induce gall formation on terminal shoots and leaves. These galls greatly reduce nut production and suppress shoot growth. After adult insects emerge, the dried, blackened galls become woody. These galls persist on older limbs for several years. In cases of severe infestations, nut production ceases, interior portions of the tree canopy die, and trees are killed.

Because the dormant larvae are not easily detected on chestnut twigs, infested plant material (i.e., scion wood) especially that used to propagate new trees, escapes detection and infests new and existing chestnut orchards. The purchase of scion wood from nurseries where the gall wasp has been identified should be avoided to limit the spread of this serious pest. Chemical controls are not feasible on trees where nuts are harvested for human consumption. Recently, navel orangeworm has been controlled in in-shell walnuts using a short exposure to an electromagnetic field in the U.S. This procedure does not present a health risk to humans or plants, but it has not been tested on chestnut shoots.

In November 2009, University of Missouri faculty met with the State Entomologist with the Missouri Department of Agriculture, and Plant Pest Control Bureau to discuss control strategies to prevent the importation of gall wasp into Missouri. As a result, a Pest Alert on gall wasp was developed, disseminated, and posted on the UMCA web site. As this insect will have a devastating impact on chestnut nut production in Missouri, the development of procedures to disinfest scion wood was designated the highest priority in preventing gall wasp from entering and limiting its spread into uninfested areas.

To address this need, a study was conducted to: 1) determine the highest temperature at which chestnut buds and scion wood can survive without tissue injury; 2) evaluate hot water immersion, forced hot air heating, and transverse electromagnetic mode (TEM) heating treatments as methods to kill oriental gall wasp larvae inside chestnut buds on scion wood; 3) verify that disinfested scion wood does not affect graft union survival and subsequent tree growth; 4) communicate the results of this study to chestnut producers in Missouri and throughout North America.

Project Approach

Scion wood was collected on 18 Jan. 2011 from 'Qing' Chinese chestnut trees in a cultivar repository at the University of Missouri Horticulture and Agroforestry Research Center near New Franklin, Missouri for a preliminary experiment to determine the lethal high temperature for buds. Six replications of five-bud segments of chestnut wood were immersed in a Neslab RTE 221 recirculating water bath (Thermo Scientific Neslab, Portsmouth, NH) at 53°C for 5, 10, or 15 min. Tissue temperature during the hot water treatment was monitored with a 0.01-mm-diameter (30 gauge) copper-constantan thermocouple placed in contact with a randomly selected sample of scion wood for each test temperature. After hot water immersion, samples were air dried for 30 min and sealed in plastic bags for 5 days at 21°C. At this time, buds were examined for tissue injury using a stereomicroscope. On 29 Feb. 2012, another test was performed in which ten replications of five-bud samples of 'Qing' scion wood were immersed in the water bath at 50 to 55°C for 5, 10, or 15 min and

bud injury was evaluated as previously described.

On 2 Mar. 2012, 'Qing' Chinese chestnut scion wood was sampled from trees growing in a commercial orchard in Mantua, Ohio. Bud wood was collected from limbs that had old *D. kuriphilus*-induced galls and shipped by overnight mail to the University of Missouri. Plant material was stored at 2°C until used for experiments. To evaluate various methods of heating using different types of equipment, five replications of five-node bud sticks were heat-treated at 53°C for 10 min at several dates in March. Hot water immersion, using the recirculating bath described above was compared with forced-air and TEM heating. A programmable chamber (Tenney Engineering, Union, N.J.) was used for forced-air heating and TEM heating unit was constructed at the University of Missouri for operation at 27 MHz as described by Wang et al. (2001). Following treatment with each piece of equipment on 5 Mar., chestnut buds were evaluated as previously described.

For the final evaluation, scion wood collected on 2 Mar. and cold-stored until 3 Apr. was immersed in water using the recirculating bath. Ten pieces of 15-cm long scion wood were plunged in water at 52 or 53°C for 10 min. After air-drying bud wood for 30 min, 30 buds each of treated and untreated control buds were whip-and-tongue grafted onto AU-Cropper container-grown seedling rootstocks. Grafted trees were then placed in the growth chamber at 24°C day/18°C night on a 12 h cycle. After four weeks, the number of trees that produced successful unions and galls was recorded, as well as the length of the growth produced from scion buds. Scion growth data were subjected to an analysis of variance using SAS (Version 9.2; SAS Institute, Cary, N.C.), $P \leq 0.05$.

Additional hot water treatments were performed to evaluate the temperature required to kill *D. kuriphilus* larvae in small (1 x 1 cm) galls following hot water immersion at temperatures ranging from 46 to 51°C for 5 min. Untreated control galls were also included in this study. Scion wood with galls was shipped from Mantua, Ohio on 11 May 2012 for this experiment. Three days later, 10 galls attached to chestnut stems were treated, sealed in bags at 21°C for 24 h, and then sectioned to evaluate larvae mortality.

Scion wood collected and tested on 18 Jan. 2011 had 100% bud survival when immersed in water at 53°C for 5 or 10 min. However, buds were damaged when exposed to 53°C for 15 min. Following hot water immersion for 15 min, 13 of 30 buds exhibited tissue injury. Results from the test performed on 29 Feb. 2012, revealed that all chestnut buds on scion wood survived hot water immersion at 50, 51, and 52°C for 5, 10, or 15 min. However, as the temperature ($> 52^\circ\text{C}$) and immersion time increased, bud injury also increased (Table 1).

When various heating methods were evaluated, there were advantages and disadvantages to each type of equipment. The forced-air Tenney chamber required about 15 min to program the equipment and heat the interior chamber to 53°C. Samples also required protection from desiccation during treatment. Additionally, when the chamber door was opened to place samples inside the equipment, the chamber temperature quickly dropped and required time to readjust to the test temperature. Samples subjected to TEM heating did not desiccate during treatment and tissue inside the unit reached 53°C within 3 min of turning on the equipment. However, our equipment failed to maintain a constant temperature during treatment. The unit at the University of Missouri cost \$18,000, but commercially-available equipment is more expensive. The recirculating bath was the least expensive equipment and the most reliable to use. It cost \$2350 and required about 10 min to heat the water. Moreover, it had minimal fluctuation in temperature ($\pm 0.1^\circ\text{C}$) during treatment. Thus, the recirculating bath was used for the final experiment.

At four weeks after grafting, 80%, 75%, and 25% of trees had formed successful graft unions when chestnut scion wood was untreated, immersed in water at 52°C for 10 min, or treated at 53°C for 10 min, respectively (Table 2). These percentages ($\geq 75\%$) of graft union success are typical when grafting a scion bud of one cultivar onto a seedling rootstock of a dissimilar cultivar. However, the low percentage of graft union success of trees with scion buds that were exposed to 53°C may be

attributed to tissue injury during treatment. These results may also indicate that scion wood collected in early winter may be more tolerant to high temperature exposure than that collected closer to bud break in the spring. It was also noted in preliminary experiments that chestnut buds on small diameter scion wood (≤ 3 mm) were more susceptible to high temperature injury than those obtained from larger diameter (5 mm) wood when sampled on the same date. Of the 24 successfully-grafted trees in which the scion buds were untreated, 10 trees produced one or more galls on the new scion growth (Table 2). In contrast, none of the successfully-grafted trees with previously heat-treated buds produced galls. Additionally, the length of the new scion growth on all grafted trees was similar after four weeks in the growth chamber.

One to three *D. kuriphilus* larvae were alive in every gall heated to 46°C for 5 min or in untreated controls. Two and four larvae inside galls were killed after hot water immersion at 48 and 49°C for 5 min, respectively. However, all *D. kuriphilus* larvae and its parasitoid in galls were killed after exposure to 49 to 51°C for 5 min.

In summary, results from this study indicate that the highest lethal temperature for ‘Qing’ Chinese chestnut buds is influenced by the time of collection, diameter of the scion wood, and the duration of the heat treatment. However, hot water immersion of scion wood at 52°C for 10 min may be a promising treatment for disinfesting *D. kuriphilus* larvae from chestnut scion wood. A lower temperature may also result in larvae mortality within buds, but such treatments were not tested in this study. Although high temperature treatment of scion wood may retard the distribution of this gall wasp into non-infested locations, it may still become established when untreated rootstocks or seedling trees are planted. To destroy *D. kuriphilus* larvae in small galls, a heat treatment at $\geq 49^\circ\text{C}$ for 5 min may be used.

Dr. Michele Warmund, MU Professor of Horticulture, conducted the tissue viability tests, the hot water immersion, and forced air heating experiments. Dr. Mark Coggeshall, UMCA Nut Tree Breeder, grafted the disinfested trees onto rootstock seedlings. Dr. Naz Islam, MU Professor of Electrical & Computer Engineering, designed the electromagnetic heating equipment and Somsak Tantong, MU graduate student, constructed the experiment. Dr. Terrell Stamps, MU Research Entomologist assessed gall wasp incidence and mortality. Dr. Warmund delivered presentations at meetings and prepared publications of this work. Shannon Bage and Audrey Davis, MU graduate students produced the rootstocks and were responsible for the daily management of plant material during the pre- and post-grafting period.

Goals & Outcomes Achieved

This study provides a promising method for disinfesting Asian gall wasp larvae from chestnut buds. After grafting bud wood that was immersed in hot water at 52°C for 10 minutes, galls were not produced. Hot water immersion was the least expensive and most reliable disinfestation method as compared to forced air and TEM methods. In Ohio, where gall wasp routinely infests chestnut buds, hot water immersion is currently being used by a commercial nursery to provide pest-free planting stock. The Canadian Food Inspection Agency has also expressed interest in using this technique to protect their commercial producers from gall wasp importation.

Public awareness of need to prevent further dissemination of the Asian gall wasp has been increased via outreach efforts. Results of this study were presented to 30 Cooperative Extension Specialists in an In-Service Training event at the Horticulture and Agroforestry Research Center (HARC) at New Franklin, MO on June 28 and 29, 2012, followed by a field day for the public at HARC (55 attendees) on June 30. Key findings of this project were also presented at the Northern Nut Growers (NNGA) annual meeting in Lexington, Kentucky on July 23, 2012 (100 attendees), the American Society for Horticultural Science meeting in Miami on August 1, 2012 (125 attendees in session), and the International Society for Horticultural Science (ISHS) Chestnut Symposium in Sheperdstown, West

Virginia on September 5, 2012 (150 attendees). A manuscript was prepared for publication in *Acta Horticulturae* and in the Northern Nut Growers 2012 Annual Report. Following publication, these articles will be posted on the University of Missouri Center for Agroforestry (UMCA) web site at: <http://www.centerforagroforestry.org/pubs/chestnutsarticle.pdf>. Due to a meeting conflict, results were not presented at the Chestnut Growers of America (CGA) meeting. However, many CGA members attended the NNGA meeting and/or the ISHS Chestnut Symposium. Thirty questions concerning the gall wasp were answered on-line via the MU Extension website and the Ask An Expert feature of the national eXtension website in 2012.

Beneficiaries

All current and future chestnut propagators and nut producers will benefit from the development of this method to disinfest oriental gall wasp larvae from chestnut wood. This disinfestation method can reduce further distribution of this insect into new chestnut tree plantings. It will also provide a method whereby new cultivars imported from gall wasp-infested areas can be sanitized to limit further distribution of this pest. Most importantly, control of this pest will ensure that additional acreage of chestnuts can be planted and grown profitably in major production regions of North America which are currently gall wasp-free. If UMCA goals are met (800 hectares of chestnuts planted by 2020), with economic projections (\$4 to \$7 million for wholesale nuts and up to \$20 million for retail nuts), the goals will be attainable.

Lessons Learned

Unexpected project delays were encountered in acquiring the TEM heating equipment from the manufacturer. Once built, testing of the TEM equipment took longer than originally anticipated. However, the proposed objective in which included TEM equipment evaluation was accomplished. All goals were achieved and additional information on the destruction of small galls and the Asian gall wasp following bud break was obtained.

Contact Person

Dr. Michele Warmund
573-882-9632
warmundm@missouri.edu

Additional Information

Table 1 Percent 'Qing' Chinese chestnut bud mortality following water immersion at various temperatures and exposure times on 29 Feb. 2012

Temperature (°C)	Time of exposure (min)		
	5	10	15
	<i>Bud mortality (%)¹</i>		
50	0	0	0
51	0	0	0
52	0	0	0
53	0	2	78

54	4	6	94
55	14	92	100

¹ Values represent ten replications of five-bud samples of scion wood at each temperature and time of treatment.

Table 2 Percent graft union success, number of trees with galls, and average length of scion growth at 4 weeks after grafting ‘Qing’ buds that had been immersed in water at 52 or 53°C for 10 min or untreated.¹

Treatment temperature (°C)	Successful grafts (%)	Number of galls/tree	Scion growth (cm) ²
52	75	0	14.9
53	25	0	18.0
Untreated	80	10	15.0

¹ Heat-treated or untreated ‘Qing’ buds were grafted onto seedling AU-Cropper rootstock.

Thirty grafted trees of each treatment were maintained in at growth chamber at 24°C day/18°C night on a 12 h cycle for 4 weeks.

² Mean scion growth among treatments was not statistically significant when analysis of variance was performed, $P \leq 0.05$.

Project 9: City Greens Bonus incentive Project

Catholic Charities of St. Louis

Karen Wallensak

Final Performance Report

Project Summary

The “City Greens” Bonus Incentive Project was created to introduce healthy, affordable Missouri specialty crops in two impoverished neighborhoods in the City of St. Louis.

Both neighborhoods – one in Midtown, and the other on the North Side - exist in so-called urban “food deserts.” There, healthy and reasonably priced food is scarce. Most families lack transportation to suburban supermarkets and instead spend their meager resources at fast food restaurants and convenience stores, buying expensive processed foods that are high in calories and low in nutrition.

Meanwhile, local small-scale farmers – many located not even 30 miles from these neighborhoods – grow fresh, affordable, healthy specialty crops and need customers to buy them.

Through the Bonus Incentive Project, Catholic Charities Community Services brought together urban poor families and specialty crop farmers to the benefit of both. CCCS has operated two “City Greens” markets in the neighborhoods, and also sends the “Supa’ Fresh Veggie Mobile” to sites in the Midtown service area. The agency recruited local farmers to supply specialty crop produce for both the stationary and mobile markets. It offered bonus incentives for low-income families using the food

stamp (SNAP) program: for every \$4 spent on specialty crop items, the project matched \$4. This allowed families to buy more food and farmers to sell more produce.

The timeliness of the Bonus Incentive Project was important. The project ran from June 2011 to September 2013, as the region slowly recovered from the impact of the recent recession. During this period, more families than ever needed SNAP benefits and projects like “City Greens” to put food on the table. Local farmers – themselves facing economic setbacks – needed access to new markets and customers. The project enabled both groups to survive difficult times while building a sustainable business model for the future.

Project Approach

Over the course of three summers, from 2011 to 2013, the “City Greens” Bonus Incentive Project enabled more impoverished families to buy wholesome food, and also educated them on the benefits of specialty crops in achieving good nutrition and health. Activities included:

Marketing/Outreach

CCCS promoted the availability of specialty crops through printed and online media. During the grant period, more than 2,140 fliers were distributed in zip codes 63101, 63106, 63112 and 63147 (north) and 63110 and 63104 (Midtown); 100 posters were created and posted in the Midtown neighborhood; and more than 3,000 post cards were mailed to 63147 residents.

The target audiences for the markets varied. In north city, “City Greens” focused on older adults receiving meals from the Fr. Tolton senior center or living in public housing. This market operated only during the summer of 2011. Midtown operated its market in 2011, 2012 and 2013. Its primary target was families – mostly single mothers with children.

Besides printed materials, the Midtown market also launched a blog at <http://www.citygreensproduce.blogspot.com> to inform the community about the destinations for the mobile market, notify customers about what specialty crops were available, and even provide recipes using specialty crop produce. Those who followed the blog also received weekly email updates. Even low-income market members embraced the blog, tapping into it online at public libraries and schools if they did not have access at home.

Market Food Sales

During the three years, shoppers spent more than \$146,905 during 5,715 visits to the two stationery markets. Of that amount, SNAP purchases represented \$12,165, or about 8.3 percent of the total. The markets prominently featured specialty crops in their displays and on their shelving. Written information about the nutritional value of the produce, along with recipes for use at home, was posted alongside the food. More than \$42,600 in specialty crops were purchased by both SNAP and non-SNAP shoppers. Specialty crops constituted 29 percent of overall sales.

Mobile Food Sales

The Supa’ Fresh Veggie Mobile made routine stops at four locations during the grant period. One site was Casa de Salud, a health clinic catering primarily to Spanish-speaking immigrants. Signage and fliers distributed at that site, then, were written in Spanish. The other three locations were at designated intersections or residential addresses. About 735 shoppers visited the mobile market during the grant period, buying more than \$9,970 in food, including about \$2,890 in specialty crops. Less than \$600 in SNAP purchases took place via the mobile market, however. This was to be expected, given that many visitors did not bring their cards, and some of the Spanish-speaking customers were undocumented and therefore could not qualify for food stamps.

Educational Opportunities

Every week of three summer market seasons offered an opportunity to provide education on specialty crops to “City Greens” customers. Over the grant period, the markets conducted 79 educational sessions. These included cooking demonstrations by volunteer chefs or culinary school students; sampling/sharing of specialty crop recipes prepared by the “Midtown Mamas” or children participating in summer youth programming; and distribution of brochures or handouts on specialty crops to homebound elders in the north city neighborhood.

Bonus Incentives

From the beginning of the project, the “City Greens” markets made bonus incentives available to low-income shoppers using SNAP (EBT/food stamps). For every \$4 in specialty crops purchased, a \$4 bonus voucher was awarded. This effectively doubled the amount of specialty crop produce that low-income shoppers were buying and taking home, and also put more money in the pockets of local farmers. Over the life of the grant award, the “City Greens” markets awarded \$3,747 in specialty crop bonus incentive vouchers to 136 low-income patrons (unduplicated), bringing their specialty crop purchases to \$7,494.

Ensuring Fidelity to Specialty Crops

One important task during the grant period was to ensure that all efforts supported through SCBGP funds promoted only specialty crops, and that the bonus incentives applied only to these crops. On an ongoing basis, “City Greens” trained workers, volunteers and customers at the markets about the definition and nature of specialty crops. Check-out procedures – which were posted at cash registers and EBT machines – required those handling transactions to log specialty crop purchases in a separate column, shopper by shopper, and mark those bought using bonus vouchers. Using these procedures, bonus incentives could be calculated properly for each customer, and specialty crop purchases could be tracked and tallied accurately each day. Since there were no other similar promotions during the grant period, it was easy to ensure that only specialty crops were being purchased with a bonus voucher. The market managers were on site to supervise check-out, double-check records and answer any questions that arose.

A variety of project partners had a hand in carrying out this work. These included:

Partners

L'Ecole Culinaire
Vatterott Culinary School
create recipes
University of Missouri Extension Service
/ recipes
Midtown Mamas
Casa de Salud
St. Louis Area Agency on Aging
(homebound and congregate meals)
RJ Sales and Marketing
UMB Bank
Missouri Botanical Garden
specialty crops
Skandalaris Center for Entrepreneurial Studies
Brown Sisters Foundation
Incarnate Word Foundation
Award
International Institute

Contribution

Student chefs to lead cooking demonstrations
Student chefs to lead cooking demonstrations &
Publications on nutritional value of specialty crops
Cooking demonstrations/recipes
Site for Supa' Fresh Veggie Mobile Market
Access to North Side seniors (receiving
Assistance with marketing/outreach efforts
Financial support for “City Greens” markets
Training for staff and volunteers/information on
Business planning for “City Greens”
Match grant for growth of “City Greens”
Funding for “City Greens” / Marketplace of Ideas
Refugee farmers

Goals & Outcomes Achieved

The initial goals for the “City Greens” Bonus Incentive Project were established for activities conducted during one summer at two market sites. A budget amendment in September 2011 changed the threshold for bonus incentives. Finally, an extension of the grant gave CCCS two additional summers of activity. CCCS made adjustments in some goals to reflect the additional time.

Activity	Goals as of Sept 2011	Suggested Revision	ACTUAL	% Achieved
Provide “bonus incentive” vouchers to low-income shoppers at “City Greens,” enabling them to double their purchase of specialty crop produce.	100 households (unduplicated)	125 households (unduplicated)	136 households (unduplicated)	108%
Provide educational opportunities for low-income shoppers at “City Greens,” teaching them the value of integrating specialty crops into their diet.	26 sessions	78 sessions	79 sessions	101%
Through sales of specialty crops to SNAP recipients in low-income neighborhoods, increase the earnings of Missouri farmers.	\$3,746.45 in incentives and \$7,492.90 in total sales	\$3,746.45 in incentives and \$7,492.90 in total sales	\$3,746.45 in incentives and \$7,492.90 in total sales	100%

To track results and measure outcomes, the market managers used reports from SNAP processing machines; sales records; logs of bonus incentives vouchers distributed; notes and sign-up sheets from educational sessions; and client demographic data gleaned from our Online Data Management (ODM) database.

Beneficiaries

Low-income recipients of SNAP (food stamps) benefits were the beneficiaries of the “City Greens” Bonus Incentive Project. In the north St. Louis target neighborhood, the beneficiaries were adults age 62 and older who had an average annual household income of \$12,006 annually. Sixty elderly SNAP recipients took advantage of the “City Greens” Bonus Incentives Project.

Midtown reached out primarily to families, about 80 percent of whom were single mothers with children whose average annual household income totaled \$11,880. The average household size is 2.7. With 76 SNAP recipients shopping at Midtown over the life of the grant period, healthy specialty crop foods reached the plates of 129 children.

About 90 percent of clients at both locations were African American.

The project had an economic impact both for beneficiaries and the farmers who sold specialty crop produce to “City Greens.” SNAP recipients received \$3,746.45 in vouchers, enabling them to buy that much more in nutritious special crop foods. Meanwhile, the local farmers earned \$7,492.90 from the combination of initial SNAP sales plus coupon sales. Additionally, non-SNAP shoppers bought \$35,107.10 in specialty crop produce at the markets. So the total economic impact to farmers was \$42,600 in sales.

Lessons Learned

The “City Greens” Bonus Incentive Project required an extension, as the spending of SNAP recipients on specialty crops was much slower than anticipated. This was due to the unfamiliarity among shoppers with the crops, which included items such as Swiss chard and amaranth greens. Families not routinely exposed to fresh produce do not know how to use these in cooking, do not understand the value of their nutritional content, and do not appreciate how good the fruits and vegetables taste. Once educational sessions featuring the specialty crops were conducted, more “City Greens” shoppers were willing to try them – and sales, consequently, built over time.

A change in personnel during the grant period also created problems with reporting on the project to the Department of Agriculture. There was no hand-off, per se, when the project’s originators left in September 2011. In fact, new management was not even aware of the grant until program monitors began to make contact about missing reports and the interruption in spending. The north side project – which had no leadership after the transition – had to be discontinued after September 2011. Activity at the Midtown site continued uninterrupted during 2012 and 2013. However, it took better than a year for management to circle back, understand the project and make sure all documentation was in place.

On a positive note, the Midtown site had unexpected success with online marketing of “City Greens” among low-income people. While many do not have internet access at home, their children do at school, and some adults are becoming familiar with the internet through public libraries. The “City Greens” blog really was aimed at non-impovertised members, but the number of low-income shoppers who mentioned it was surprising and interesting.

Contact Person

Karen Wallensak
314-932-3305
kwallensak@ccstl.org

Additional Information

In its grant application, Catholic Charities Community Services committed to a \$2,800 match for the project. Additional funds raised for “City Greens” totaled \$56,040 (this does not include membership fees or market sales), and there were 850 volunteer hours documented at a value of \$8,580.

The growth of “City Greens” in the Midtown area has necessitated a move to bigger and more accessible space. “City Greens” will debut in January at a storefront along a major east/west thoroughfare in the neighborhood. With expanded market days and hours, sales are expected to grow significantly, which will create more opportunities for promoting specialty crops.

During the project period, a photo exhibit of the “City Greens” program at Midtown was displayed at the University of Missouri-St. Louis. Also, the online newspaper “St. Louis Beacon” featured a story on “City Greens.”



Project 10: Enhancing Missouri Specialty Crop Opportunities through Training & Outreach

Thomas Jefferson Institute

Jerry Nelson

Final Performance Report

Project Summary

The objectives of this project were to provide field training sessions to Missouri producers on several types of specialty crops and to increase public awareness of specialty crops that can be purchased locally from Missouri producers. Specialty crops showcased were cool and warm season vegetables, tree fruits including peaches, apples, European and Asian pears, tart cherries, paw paws, blueberries, grapes, blackberries, raspberries and tree nuts.

The activities fulfilled for this project centered on the use of extensive specialty crop demonstrations at the Thomas Jefferson Agricultural Institute's, Jefferson Farm & Gardens. The 67-acre Jefferson Farm, a nonprofit educational facility located in Columbia, MO, showcased more than 300 cultivars of fruits and vegetables during 2011. These demonstrations were used as part of training and education programs for both producers and the general public.

Public outreach efforts included tours of specialty crops for the general public, with the primary beneficiaries of this project to Missouri producers who were growing or interested in producing specific specialty crop varieties in this region. New specialty crop publications were created and media coverage provided awareness.

The project was timely given the increasing interest in purchasing locally grown fruits and vegetables. Increasing consumer demand has created an important opportunity for Missouri producers to direct market and diversify into potentially profitable specialty crops.

Project Approach

This project made use of the extensive specialty crop demonstrations at Jefferson Farm in programs for both Missouri Producers and the general public. These crops consisted of a fruit orchard with over 50 cultivars of peaches, apples, pears, cherries, and paw paws; a blueberry demonstration with 17 cultivars; grape demonstrations and a garden with annual plantings of 200 cultivars of vegetables, herbs and herbaceous fruit.

Beginning in January, vegetable seeds were started in the greenhouse and then transplanted to the vegetable garden. Early spring rainy weather and the extreme heat delayed some plantings. In April the cool-season vegetables were direct seeded. In the orchard the fruit trees have been pruned and the fruit has been thinned. These demonstrations are key components of our farm education programs for school and community groups as well as producers.

March through October, we scheduled tours of the Jefferson Farm & Gardens with school and community groups throughout Missouri. Throughout 2011, more than 700 students toured the farm. During the tour students learned about vegetable production and varieties from our staff horticulturalist and youth educator. Students were informed of the importance of fruits and vegetables in their diets as well as the variety of Missouri produce available during the seasons. They visited the garden, fruit orchard and saw the blueberry, raspberry and blackberry demonstrations. In many cases the students have been able to sample some of the produce during their visit.

2011 Jefferson Institute Farm Tours for School/Community Groups		
Date	Group	# of Students
4/22	Columbia Derby Ridge 2 nd grade	86
5/13	Columbia South Park 1 st grade	105
5/10	Hallsville 2 nd grade	103
5/11	New Franklin 1 st grade	33
5/20	Columbia Derby Ridge 1 st grade	68
6/6	Columbia Boy scouts	50
6/7	McCready Community Club	15
6/24	Columbia Summer school	15
7/8	Apple School	20
7/15	Apple School	15
7/26	Kauffman Scholars	44
7/27	Dog Days Summer Camp	20
9/26	Boonville Preschool	10
9/28	Columbia Islamic School	11
9/29	Columbia Islamic School	24
10/14-15	Columbia Boy scouts campout	100

On Saturday, June 18th we had an open house at the farm for the general public attended by more the 165 children and adults. As part of this day visitors were able to sample our blueberries and tour our orchard and gardens. A secondary emphasis was made by increasing awareness of fruits and

vegetables and potentially stimulating a demand to purchase locally-grown specialty crops among the general public consumers at the open house.

We partnered with University of Missouri staff on June 21st and 22nd to present a workshop on Beginning Organic Vegetable Production. More than 25 beginning Missouri farmers attended. As part of this workshop our staff horticulturalist gave a tour of the garden, fruit orchards and berry plantings. Some vegetables and several cultivars of strawberries were ready for harvest allowing participants to learn first-hand the quality and taste differences among cultivars.

July began with the harvest of cool-season crops including rutabagas, kohlrabi, lettuce, Swiss chard, beets, cabbage, turnips, cauliflower, broccoli, onions and potatoes. The beds were prepared for a fall crop of vegetables. The blueberry harvest was completed in early July. In late July, the peach crop ripened and was harvested for the food bank. The blueberry and bramble beds were prepared for fall by adding mulch around the plants. The sweet corn was harvested in late August. Cucumbers, zucchini and squash ripened in late August and continued producing until mid-September. The extreme summer heat markedly reduced fruit set of the tomatoes, delaying the tomato harvest and reduced yields in some cases. Our grape trellis demonstration was completed. The demonstration showcases three different trellis systems including the H-brace end post system, Geneva double-curtain system, and end-post system with earth anchors. Specialty melons and watermelons ripened in time for our melon field day on September 1, 2011. These demonstrations were key components of our farm education programs for school and community groups as well as producers.

In addition to scheduled tours, we had “open gate days” throughout July, on Monday and Wednesday mornings and Thursday evenings. As part of this program participants could tour our specialty crop demonstrations. Our staff was available during these tours to answer questions and discuss special topics. Also available was a guide listing all the vegetable varieties planted in the Jefferson Garden with growing information on each. This was available for anyone visiting the farm throughout the seasons. Thursday evenings we offered short programs on special topics. On July 21, James Quinn, MU Extension Regional Staff Horticulture Specialist, was available to answer questions on cultivar performance, potential profitability, direct marketing options and basic growing of fruits and vegetables.

Assisting the specialty crop demonstrations were three undergraduate interns that maintained the gardens and harvested the fruits and vegetables. The total produce donated for the year was 2,689 pounds to the Central Missouri Food Bank.

September 1, we presented a program focusing on growing specialty melons. Mr. James Quinn, MU Extension Regional Staff Horticulture Specialist, presented a program discussing diseases, insects and other melon pests. Dr. David Trinklein, Associate Professor of Plant Sciences with the University of Missouri, gave a presentation on melon history, varieties performance and harvest timing. As part of the field day, participants were able to sample more than 20 varieties of melons grown both at Jefferson Farm & Gardens and the University of Missouri Bradford Farm.

We prepared information sheets on each variety including seed sources. Through our group tours, open gate days, and melon field day, 40 Missouri producers received training on specialty crops throughout the growing season. The majority of the attendees gained new information on cultivars and sustainable management techniques for specialty crops. Ninety percent of the public who toured Jefferson Farm either during the school field trips, melon field day or open gate days were informed of the available fruits and vegetables produced in Missouri and the venues where they could buy local produce and therefore have a better idea of what is available to grow and buy locally.

The extreme heat reduced the attendance at some of our scheduled events. Due to reduced staffing, of the Jefferson Institute, follow-up surveys were not sent to the training participants in 2012. Staff

logged hours devoted to maintenance of specialty crop demonstrations as well as tours and training sessions on specialty crops.

Goals & Outcomes Achieved

Demonstrations accomplished:

- Provided scheduled tours of our specialty crop demonstrations to over 700 school children and adults.
- Held an open house for the general public that was attended by more the 165 children and adults.
- “Open Gate Day” tours were offered 3 days a week in July providing at least 90% of the general public touring the farm a better idea of which fruits and vegetables are produced in Missouri and available to buy locally.

Trainings accomplished:

- Partnered with University of Missouri and presented a program on beginning organic farming which featured a tour of our specialty crop demonstrations. This program was attended by more than 25 beginning farmers
- Presented a workshop for growing specialty melons that was attended by more than 15 producers and/or potential producers
- Published specialty crop guides and made them available at the trainings and on the Jefferson Farm website

Public awareness accomplished:

- Demonstration tours allowed discussions to public audiences stating advantages of consuming locally-grown fruits and vegetables and encouraged the consideration of buying specialty crops directly from Missouri producers through farmers markets, CSA's, roadside stands, or to give preference to Missouri grown specialty crops when making selections at a grocery store.
- Visitors were permitted to sample fruit or vegetables in season during their tour encouraging the consumption and flavorful tastes of fresh locally grown specialty crops.

Beneficiaries

The main groups attending our educational activities were Missouri beginning farmers and Missouri school children.

The school children came away from the tours with a better understanding of the availability and variety of crops available in Missouri. The producers were able to gain information on many new cultivars as well as specialty crops and management practices for specialty crops they were considering growing.

Lessons Learned

Due to our small staff we were challenged to reach maximum effectiveness in achieving all the goals of this project, but we found through making use of the variety of demonstrations at the Jefferson farm and by partnering with other organizations, we were able to achieve the project goals.

The extremely hot and dry weather during our project period made it extremely challenging to maintain the demonstrations and attract visitors to our events. We were able to improve attendance by having some evening events.

Due to reduced staffing, follow-up surveys were not sent to the training participants in 2012. The Thomas Jefferson Agricultural Institute's Jefferson Farm & Gardens site is no longer continuing operation due to lack of funding at this time.

Project 11: Increasing Child & Adult Nutrition Knowledge & Consumption of Specialty Crops in Southwest Missouri through Social Media & Video Marketing

Webb City Farmers Market

Eileen Nichols

Final Performance Report

Project Summary

Southwest Missouri has a substantial and growing number of farmers markets, however the markets serve only a fraction of the region's consumers. Many residents are unaware of the nutritious specialty crops available through farmers markets. Many don't know how to select and prepare fresh fruits and vegetables or the importance of incorporating fresh produce into their diets.

In order for markets, and their specialty crop farmers, to prosper and expand an increasing number of customers must be educated and motivated to increase their consumption of fresh, local produce, which in turn will result in a healthier population.

Project Approach

The initial proposal had a large component which could be labeled "the market lady project". This project included cooking demonstration at 20 farmers markets in the area. Some of the demonstrations were to be video-taped and produced into short segments for distribution through KY3 in Springfield and KSN in Joplin. In addition, a blog, web site and facebook page were to be established and maintained sharing news, recipes and tips from "the market lady". The second and much smaller component was a lesson plan for fourth-graders about incorporating specialty crops into their diets based on the Five-a-Day-Plan.

The market lady consultant did a great job developing the brand, internet sites and doing cooking demonstrations during year one. In the first year, the Facebook page had 609 friends with 1,106 monthly users, The blog had 6,134 hits since going live in the spring to the end of year one. Two brochures featuring seasonal recipes and directing consumers to the market lady internet sites were produced and distributed to participating markets. Forty-five video segments were produced and distributed.

In year one and two the Missouri State University, School of Agriculture provided the equipment to video tape and produce the segments.

In year three, the University of Missouri Extension worked closely with the market in providing staff once a week during the high season to demonstrate preparation of specialty crops. These demonstrations and the recipes supplemented the weekly market lady demonstrations and were often

used as material for market lady print food stories. This partnership was so successful that MU Extension hopes to expand it to other markets in the state next year.

The lesson plan was created as proposed, but has not been distributed due to major changes by the CDC in their nutrition program and anticipated changes in the national core curriculum plan.

Goals & Outcomes Achieved

The goals were: Increasing the consumption of fruits and vegetables by educating the public as to the nutritional value of locally available specialty crops, where to buy local specialty crops and how to select and prepare them, and expanding the customer base of specialty crop farmers through farmers markets.

To achieve these goals, multiple cooking demonstrations were done at 20 participating markets, plus another 23 at the Webb City Farmers Market in year 3, and an additional 18 cooking demonstrations in year 3 at the Webb City Farmers Market by the University of Missouri Extension. 45 videos focusing on using specialty crops were produced and distributed to KY3 and KSN and posted on the market lady blog. Two brochures with seasonal recipes for specialty crops were printed and distributed through the 20 participating markets. Facebook, twitter, a blog and a web site distributed tips, recipes, videos and photos of the market lady activities, all of which can be measured. Dot surveys were conducted at the Webb City Farmers Market and the Fair Grove Farmers Market to determine customer counts, customer spending, distance traveled to market and where information on the markets was being secured by customers. Presentations on the project were given at the Missouri Farmers Market Association annual meeting and to the Mississippi River Hills Association.

Goals

- Determine video filming schedule with 25 southwest Missouri markets and begin filming 5/11 – *total of 20 markets signed up – accomplished on schedule.*
- Evaluate the percent of the target market reached through the market videos/website 11/11 – *not accomplished.*
- Provide healthy nutritionally balanced recipes on website and in video segments beginning 5/11 – *accomplished on schedule.*
- Develop and distribute marketing materials to promote the website and videos to the region through brochures and fliers in 5/11 – *accomplished in June 2011 and in September 2011.*
- Develop, with the assistance of teaching professionals, a lesson plan that meets Missouri's core curriculum criteria immediately upon award of grant – *accomplished in on schedule but now needs revision.*
- Launch social media marketing campaign, obtaining 2,000 Fans on Facebook in spring 2011 – *launched on schedule but has 857 friends.*
- Record monthly the web traffic of site upon establishment of web site – *accomplished automatically by site.*
- Participating markets will report increase in sales at the closing of project to determine new market shares. At least 2 markets will provide data demonstrating increased specialty crop sales at farmers' markets 30 % over the course of one market season in fall 2011 - *Data collection accomplished on schedule. No increase in sales shown but could not be expected given the terrible growing season in 2012 with more than 30 days of over 100 degrees. From 2012 to 2013, one of the markets on which data was collected showed an increase of more than 50% in sales.*
- Present project at the annual Missouri Farmers' Market Association Meeting and up to 2 other regional meetings in winter 2012 – *MFMA presentation and 1 additional presentation accomplished on schedule.*

- Disseminate all information to the industry, public and other stakeholder groups. The information and development of all aspects of project will be provided to other regions across the state for possible replication upon conclusion of the project – *this information was shared through the Missouri Farmers Market Association. We received many requests from other markets for a market lady visit but did not have funding to send her to other sections of the state.*

All data as of 10/13

- Facebook page – 857 fans of which 84% are women and 45% are in the target age area of 25 to 45. Reach in 2013 has been as high as 5,690 on a single post. 28 posts were published in 2013.
- themarketladyblog.com – in the last three years there have been 132 posts, currently there are 33 followers however the blog has had 4,412 hits through its link to the market lady facebook page. Reports of a total of 15,704 views of the blog.
- Themarketlady.com – the web site is a static site that is updated periodically – four times during the 2013 season. It primarily directs traffic to the blog and Facebook page and provides photos information on the market ladies and the guests of the market ladies.
- Dot survey results are attached.

Beneficiaries

The beneficiaries of this project include:

- The general population of Southwest Missouri who will learn about a variety of aspects of local specialty crops, allowing them to significantly improve their food options and diets and positively impact their health.
- The state medical industry and insured residents will benefit from improved health of low-income Southwest Missourians.
- Specialty crop farmers of Southwest Missouri will become more financially stable with increased sales from area farmers markets.
- Farmers markets of Southwest Missouri will become more viable with increased sales of specialty crops.

More than 70 different cooking demonstrations held on 43 market days educated the public regarding incorporating more specialty crops into their diets reaching an estimated 5,000 people. 45 videos distributed to KY3 and KSN with a reach of over 400,000 viewers. Anecdotal information: when cooking demonstrations were given on Asian specialty crops such as long bean or unfamiliar crops such as kohlrabi, those crops sold out that market day. Additional benefit to the markets: having cooking demonstrations regularly on site reinforces the image of healthy, easily prepared fresh, local specialty crops and gives customers an additional reason to attend the market.

Lessons Learned

In year one of the grant, the goals for the market lady were accomplished, with the exception that the number of videos produced and distributed was less than anticipated. This exception was in large part due to two factors. 1) The market lady consultant used a university intern for video-taping and production rather than hiring a professional crew as originally planned. This saved significant money but resulted in far fewer videos. The consultant had to complete most of the production. 2) Expectations became unrealistic.

In addition, because the videos were not professionally produced many were of less quality than desired; some were completely unusable primarily due to audio problems. More planning and more realistic goals are required to ensure the quality.

In year two, the Webb City Farmers Market planned to film the remaining segments. 1) the intern hired for the year two season was unreliable and inexperienced and 2) medical restrictions prevented the market lady consultant from working except at the very beginning of the season. Additional activities further limited her time.

In year three, the Webb City Farmers Market terminated the arrangement with the consultant and took a new approach. Have the market lady food demonstrations only at the Webb City Farmers Market and use those demonstrations as a basis for a weekly print food story with photos broadcast to print media in Southwest Missouri. By having the market in direct control of the project proved to be successful. The Webb City Farmers Market was able to secure competent and reliable food professionals to demonstrate. All of the food stories receive wide public distribution because of the project manager's extensive experience and good contacts in print journalism. After a learning curve, the Internet-based sites were actively maintained by the project manager. The food stories, plus tips from market ladies, provided material to update the Facebook and blog pages frequently.

The lesson plan was seriously impacted by the government's change from the Five- A-Day program to the MyPlate.gov program. This change required an almost complete rewrite further complicated by the prospect of implementation of the national common core curriculum. Changes have settled enough for the Webb City Farmers Market to continue with this part of the project and complete with its own resources.

A cooking demonstration program funded through a grant from the Missouri Foundation for Health in 2012, resulted in the market having good contacts within the professional food and nutrition community. In addition, the market teamed with Extension in year three and was able to double both the demonstrations held at the market and the resource material for the weekly food stories.

The Webb City Farmers Market learned that it worked much better to maintain complete control of the project and hire consultants to do components of the project. The government changes affected the lesson plan component and seriously impacted both time spent and timeliness of implementation.

Contact Person

Eileen Nichols
417-483-8139
eileennichols@sbcglobal.net

Additional Information

Customer Surveys

Webb City - Saturday - 7/31/10 – Conducted by Cody Vaughn			
Questions		Customer Count	Percentage
How far did you travel to reach the market today?	Less than 5 miles	84	39.99%
	5-9 miles	54	25.71%
	10-20 miles	41	19.52%
	More than 20 miles	31	14.76%
	Total	210	

How often do you usually come to the market?	Once a week	52	24.88%
	2 or 3 times a month	69	33.01%
	Once a month	26	12.44%
	Less than once a Month	23	11.00%
	This is my first visit to the market	39	18.66%
	Total	209	
How did you learn of the market?	Word of mouth	105	50.23%
	Newspaper	30	14.35%
	TV	8	3.82%
	Brochure	0	0%
	Other (internet)	66	31.57%
	Total	209	
How much do you plan to spend at the market today?	Less than \$5	15	7.14%
	\$5 – 10	79	37.62%
	\$11 – 20	76	36.19%
	More than \$20	40	25.94%
	Total	210	

Webb City - Friday - August 6, 2010 – Conducted by Cody Vaughn

How often do you usually come to the market?	Once a week	71	30.70%
	2 or 3 times a month	70	30.20%
	Once a month	31	13.4%
	Less than once a month	37	15.90%
	This is my first visit to the market	23	9.90%
	Total	232	
How did you learn of the market or what reminded you to come today?	Word of mouth	139	59.90%
	Newspaper	31	13.40%
	TV	5	2.20%
	Sign	19	8.20%
	Face Book	6	2.60%
	Blog	1	0.40%
	Web site	4	1.70%
	Other (mother, brochure, grocery store recommended)	27	11.60%
	Total	232	
How far did you travel to come to the market?	Less than 5 miles	93	40.40%
	5 to 9 miles	64	27.80%
	10 to 20 miles	35	15.20%
	More than 20 miles		
	(Moscow, Russia, Zimbabwe, Congo, Texas, Kansas, Florida, Minnesota)	38	16.50%
	Total	230	
How much do you plan to spend at the market today?	Less than \$5	22	9.70%
	\$5 to \$9	73	32.30%
	\$11 to \$20	83	36.70%
	More than \$20	48	21.20%
	Total	226	

Fair Grove – Wednesday, August 4, 2010 – Conducted by Eileen Nichols

How far did you travel to reach the market today?	Less than 5 miles	47	44.80%
	5-9 miles	18	17.00%
	10-20 miles	24	22.80%
	More than 20 miles	16	15.20%
	Total	105	
How often do you usually come to the market?	Once a week	39	37.00%
	2 or 3 times a month	40	38.00%
	Once a month	10	9.50%
	Less than once a month	5	4.60%
	This is my first visit to the market	11	10.50%

	Total	105	
How much do you plan to spend at the market today?	Less than \$5	8	7.70%
	\$5 – 10	42	41.20%
	\$11 – 20	36	35.30%
	More than \$20	18	17.60%
	Total	104	
How did you learn of the market or what reminded you to come today?	Word of mouth	44	41.40%
	Newspaper	4	3.80%
	Sign	25	23.50%
	Blog	1	1.00%
	Web site	1	1.00%
	Other	31	29.10%
	Total	106	
Webb City - Tuesday - August, 2011			
How much do you plan to spend today?	Less than \$5	4	5.00%
	\$5 – 10	26	30.00%
	\$11 – 20	37	43.00%
	More than \$20	18	21.00%
	Total	85	
How did you learn of the market?	Word of mouth	41	46.00%
	Newspaper	13	15.00%
	Sign	7	8.00%
	Internet/Facebook	2	2.00%
	Other	26	29.00%
	Total	89	
How far did you travel to reach the market today?	Less than 5 miles	46	53.00%
	5-9 miles	22	25.00%
	10-20 miles	9	10.00%
	More than 20 miles	10	12.00%
	Total	87	
How often do you shop at the market?	Once a week	40	46.00%
	2 or 3 times a month	20	23.00%
	Once a month	9	10.00%
	Less than once a month	5	6.00%
	This is my first visit to the market	13	15.00%
	Total	87	
Webb City - Saturday - August, 2011			
How much do you plan to spend today?	Less than \$5	4	5.00%
	\$5 – 10	23	32.00%
	\$11 – 20	26	35.00%
	More than \$20	21	28.00%
	Total	74	
How did you learn of the market?	Word of mouth	48	65.00%
	Newspaper	9	12.00%
	TV	2	3.00%
	Sign	6	8.00%
	Internet/Facebook	1	1.00%
	Other	8	11.00%
	Total	74	
How far did you travel to reach the market today?	Less than 5 miles	25	33.00%
	5-9 miles	28	37.00%
	10-20 miles	18	23.00%
	More than 20 miles	3	4.00%
	Total	74	
How often do you shop at the market?	Once a week	28	38.00%
	2 or 3 times a month	22	30.00%

	Once a month	4	5.00%
	Less than once a month	7	9.00%
	This is my first visit to the market	13	18.00%
	Total	74	
Fair Grove - Wednesday - August, 2011			
How much do you plan to spend today?	Less than \$5	17	5.00%
	\$5 – 10	12	32.00%
	\$11 – 20	27	35.00%
	More than \$20	14	28.00%
	Total	70	
How did you learn of the market?	Word of mouth	60	82.00%
	Newspaper	5	7.00%
	Sign	8	11.00%
	Total	73	
How far did you travel to reach the market today?	Less than 5 miles	22	30.00%
	5-9 miles	23	32.00%
	10-20 miles	20	28.00%
	More than 20 miles	7	10.00%
	Total	72	
How often do you shop at the market?	Once a week	41	41.00%
	2 or 3 times a month	15	15.00%
	Once a month	9	9.00%
	Less than once a month	7	7.00%
	Total	72	

Project 12: City Seeds

Gateway Greening

Andrea Mayrose

Final Performance Report

Project Summary

The number of producers of specialty crops in the St. Louis region has not kept up with the sharp rise in farmers markets seeking vendors, nor the increased demand for locally grown fresh food by consumers. However, there is no shortage in people *wanting to learn* how to grow specialty crops. Gateway Greening (GGI) offers a therapeutic horticulture program and job-training program to St. Patrick Center clients that may be dealing with homelessness, substance abuse, mental illness, unemployment and recent prison release. By learning specialty crop production, clients learn a valuable skill while producing and distributing more fruits and vegetables throughout the region. This grant was especially important and timely in that Gateway Greening is seeing unprecedented demand for urban agriculture education (among clients, volunteers, students and the general public) and there is an immediate economic need to provide accessible and relevant job training for the underserved in this slow economy. This funding did not build upon a previous Specialty Crop Block Grant.

Project Approach

To successfully train up to 80 adults/year in specialty crop production, activities included daily instruction at City Seeds Urban Farm (CSUF) with formal classes, hands-on demonstrations and field work. Guest speakers contributed monthly cooking and nutrition demonstrations and employer-led topics like irrigation and hardscape. Weekly training at the farmer's market gave clients customer service and retail skills. Monthly field trips to Gateway Greening's hoop houses, the Missouri Botanical Garden, and places like Operation Food Search provided insight into the bigger picture on food production and distribution throughout St. Louis. Individual, group volunteers and tours at City Seeds Urban Farm provided on-going education and outreach efforts to raise awareness about the importance of specialty crops and insights into the local food system.

Program graduations were especially touching. Whether the accomplishments were recognized from the 10-week job-training graduates or 15-week therapeutic horticulture group – each and every occasion was marked with touching remarks and testimonials by participants. Significant program results include life and job skills, increased self-confidence, sobriety, sound mental health and self-sufficiency for over 450 clients. Since the establishment of City Seeds Urban Farm over 55,000 pounds of local, affordable, organic high quality produce has been distributed. Challenges and sudden changes have consisted of the transitional nature of this population, staff turnover, and changes in funding.

This project is extensive in project partners and collaboration. St. Patrick Center provides screening for client selection in the program and is responsible for providing the soft skills necessary for successful employment. Operation Food Search offers nutrition training with its cooking classes. Gateway Greening provides the horticultural training and directs the running of the City Seeds Urban Farm. Food Outreach provides nutritional support to individuals dealing with HIV/AIDS and cancer. They purchase and distribute produce from City Seeds

Urban Farm St. Patrick Center and Gateway Greening work with leaders in the green industry to educate employers on the benefits of hiring graduates. GGI networks with area businesses to provide appropriate learning and technical experiences for participants. Horstmann Brothers Landscaping is an area employer that has provided hardscape, irrigation and mowing training and has hired multiple graduates.

Goals & Outcomes Achieved

The activities described above include daily teaching and instruction at CSUF, formal classes off-site, hands-on demonstrations and fieldwork. Field trips, guest speakers, cooking demonstrations and work at a farmer's market, were all aspects included in the training curriculums. Therapeutic horticulture clients also participated in the production of value-added products including herb vinegars, honey and lip balm. Commercial mowing, OSHA training (Occupational Safety and Health Administration), and work experiences at Forest Park Forever offer a diverse learning experience. Progress is tracked on client performance through daily attendance, weekly homework and reading assignments, field competencies, behavioral evaluations, pre & posttests, surveys, assessments and informal feedback. To track farm production, harvest weights were recorded, sales, donations and the distribution breakdown to compare each year.

Year	Criteria	2011	2012	2013
------	----------	------	------	------

Performance Measure #1	No. of participants enrolled in programs	78	70	85
Performance Measure #2	Harvested (Pounds)	11,059	9,412	13,840
	Sales	\$16,964	\$16,727	\$16,687
	Donated (Pounds)	2,411	2,167	3,376
Target	Up to 80 clients graduate	43	39	55
	10,000 lbs. distributed	11,059 lbs.	9,412 lbs.	13,840 lbs.

Substantial progress has been made on specialty crop production and distribution. Initially a target of 10,000 lbs. distributed, this target was surpassed in both 2011 and 2013 by over 1,000 lbs. The 2012 harvest was slightly lower than the target due to extreme high temperatures, drought and pest pressure that year. Although on average, 80 clients participated in the programs each year graduates rates were lower due to the transitional nature of this population. Medical issues, relapse, recidivism, employment and change of heart were common reasons clients left the program. Occasionally, GGI staff had to dismiss participants as well due to attendance or behavioral issues. Overall, Gateway Greening has reached the program goals in that clients have learned how to grow and market specialty crops and we have increased the production and distribution of specialty crops to food insecure neighborhoods. This is further demonstrated by over 65% of job training graduates being successfully placed in employment and 100% of program graduates improving on their pre and post test scores. Please note the following data on the 2013 therapeutic horticulture participants:

- 79% of participants reported maintaining or increasing the amount of fruit or vegetables they eat daily.
- 93% of participants reported maintaining or increasing their sense of self-confidence
- 57% of participants reported maintaining or increasing their sense of happiness
- 71% of participants reported maintaining or increasing their ability to cope with stress
- 93% of participants demonstrated maintaining or improving in their general horticulture knowledge.
- 86% of participants reported remaining free from using illegal or non-prescription drugs (i.e. marijuana, crack/cocaine, speed, methamphetamines, heroin, or non-prescription opiates).
- 86% of participants did not increase the amount of alcoholic drinks that they would consume on a single occasion

Beneficiaries

Beneficiaries to this project are many and diverse. St. Patrick Center clientele benefitting from CSUF include individuals dealing with unemployment, homelessness, substance abuse, mental illness and recent prison release. During this grant period 233 St. Patrick Center clients were served. Since selling produce to Food Outreach, over 18,000 lbs. of produce have directly benefitted thousands of the food-insecure clients dealing with HIV/AIDS and cancer. Since

CSUF was established in 2006, 18,233 lbs. of specialty crops have been donated to food banks, transitional housing facilities and shelters. In that time period 13,986 total volunteer hours have been served at CSUF informing thousands on the importance of specialty crops, urban agriculture and providing an introduction on production. School field trips, public tours and presentations have also consistently educated the public on these topics.

In this three-year grant period, \$50,379 in produce sales has occurred, directly impacting the program and the economy. Farmer's market and wholesale sales will benefit client stipends, supply purchases, utilities, plant material, etc. The skills that are learned by clients are limitless in their potential economic impact; they can supplement their lifetime food budget with food they can grow themselves. Clients will have the knowledge to produce and sell specialty crops to the public. With the additional job skills they will obtain from the program, once employed, they will have more available funds to support a well-rounded diet. Once trained, the clients move out of the non-profit realm and into income generating positions that will take them off of public assistance and into the realm of self-sufficiency, able to perform knowledgeably, farm tasks in for-profit enterprises.

Lessons Learned

CSUF continues to successfully train clients on specialty crop production while distributing affordable, local, organic produce. In this three-year grant period, program activities continued on track but new lessons were learned. GGI will continue to improve the program by focusing on changes with client tracking, distribution, funding and community outreach. The transient nature of the St. Patrick Center population makes tracking long-term outcomes especially difficult. Likewise, reliance on partners for consistently tracking and communicating relevant program data can be challenging. Moving forward, St. Patrick Center is going to streamline reporting for 18-20 case managers and include additional outcomes, like housing. Gateway Greening has designed an independent client intake system may work towards taking over this program aspect and job placement in the long term.

To improve program financial sustainability, Gateway Greening will also focus on developing employer sponsorships and alternative funding sources. CSUF market sales will be relocated to Bell Garden (GGI's outdoor office and St. Louis' largest community garden) for 2014 and beyond. This will unite farm programming with GGI's community, youth gardens and civic greening components. Bell Garden sales will also provide more direct community impact. GGI is also working at increasing and consolidating wholesale produce sales, acting as a potential food distributor for community garden production through Bell. Gateway Greening reaches out to hundreds of individuals through tours and presentations, in order to better capture these numbers – CSUF staff will get information sheets from each attendant starting in 2014. An additional lesson learned is the importance of a permanent site. Recent development changes in St. Louis will affect the CSUF site. GGI is working with community leaders and partners to find a larger, permanent home for the farm programming so we may continue to educate our community on the importance of growing and distributing specialty crops.

Contact Person

Andrea Mayrose, Urban Agriculture Manager
314-588-9600 ext. 110
andrea@gatewaygreening.org

Additional Information







Project 13: High Tunnel Production of High Lycopene Tomatoes Using a New Disease Resistant Rootstock

University of Missouri, Division of Plant Sciences

David Trinklein

Final Performance Report

Project Summary

The demand for locally-grown produce in Missouri has never been greater. Concerns over the safety, quality and nutritional content of produce imported from other states and/or countries have made vegetables an attractive alternative cash crop for Missouri farmers.

Accordingly, high tunnel production of tomatoes in Missouri is rapidly increasing as producers obtain premium prices for high quality, early season tomatoes. Tomatoes can be produced in tunnels for several years, but ultimately, soil-borne diseases, including root-knot nematodes, can become problematic. For sustained productivity, grafted tomato plants on a disease and nematode-resistant rootstock may be a necessity. While the production of grafted tomatoes is widespread in Asia, it is relatively new in the United States.

‘Trooper’ (*Solanum lycopersicon* x *S. hirsutum*) is new tomato rootstock introduced to North America in 2010. It carries resistance to tomato mosaic virus, *Fusarium* and *Verticillium* wilt, *Fusarium* crown and root rot, corky root rot, and nematodes.

Plant geneticists have identified a recessive gene (named ‘crimson’) which, when present in the homozygous state, imparts a deeper red color resulting from a lycopene content 50 percent higher than regular tomato fruit. Recent research has shown lycopene to be a potent anti-oxidant associated with decreased incidence of certain cancers, coronary heart disease, and cataracts. Tomato is the primary source of lycopene in the human diet.

‘Health Kick’ is a relatively new tomato cultivar that carries the crimson gene. It is a large saladette tomato that has an intense red flesh color along with a high lycopene content. While ‘Health Kick’ has many attributes, it is susceptible to certain diseases, which limit yield. However, production may be enhanced by grafting ‘Health Kick’ onto ‘Trooper’ rootstock.

The objective of this study was to investigate the influence of grafting ‘Health Kick’ tomato onto ‘Trooper’ rootstock on the production of high-lycopene tomatoes under high tunnel production conditions.

Project Approach

On March 20, 2012 seeds of the tomato rootstock ‘Trooper’ were sown in plastic bedding plant trays using ProMix BX (Premier Peat Company) as a germination medium. Following seeding, the trays were placed in a controlled environmental chamber where they were exposed to a temperature of 26°C (79°F), 80% relative humidity and a 12 hour photoperiod. On March 23, 2012, the same procedure was followed using ‘Health Kick’ tomato seeds. The difference in sowing date reflects the difference in germination time between the two varieties determined in trials conducted earlier.

On March 28, 2012, seedlings of both ‘Health Kick’ and ‘Trooper’ were transplanted into plastic bedding plant packs filled with ProMix BX. Packs contained four cells measuring 5.1 cm. (2 in.) by 5.7 cm. (2.25 in.) each. When seedling stems of both cultivars approximated 2 mm in diameter, 40

'Health Kick' seedlings were grafted onto 'Trooper' rootstock using silicone tubular grafting clips (Seedway Seed Co.). Additionally, 40 'Health Kick' seedlings were allowed to develop on their own rootstock to serve as a control. All seedlings remained in the plant growth chamber whose environmental conditions were described in the previous paragraph until the establishment of graft unions on those seedlings that were grafted.

Following that, all seedlings were moved to a greenhouse at the University's Ashland Road research facility to grow to transplantable size. There, they were exposed to temperatures of 26°C (78°F) day and 18°C (65°F) night and fed (continuous liquid feed) a nutrient solution containing 250 ppm N, 62 ppm P₂O₅ and 238 ppm K₂O derived from Peters Excel 20-5-19 fertilizer (Scotts Miracle-Gro Company).

On April 30, 2012 both grafted seedlings and those growing on their own rootstock were transplanted into a high tunnel located at the University of Missouri's Bradford Research and Extension Center. Five replications each containing seven replicate plants of the two treatments (grafted and un-grafted) were planted on 24 inch centers in rows spaced 36 inches apart in a randomized complete block design. Prior analysis of the soil (see Appendix) revealed adequate-to-high levels of nutrients; therefore a pre-plant fertilizer was not applied. Immediately after transplanting, all plants received approximately 200 cc of a nutrient solution derived from Peters 9-45-15 (Scotts Miracle-Gro Company) mixed at the rate of 540 ppm N, 2700 ppm P₂O₅ and 900 ppm K₂O. Beginning on June 25, 2012 and continuing on a weekly basis throughout the life of the crop, greenhouse grade calcium nitrate (Viking Ship Brand) was applied via drip irrigation at the rate of 130 grams fertilizer per 30.5 meters of row.

Plants were supported using the short-stake weave system. Water was supplied via drip irrigation; the amount supplied varied according to the age of the crop. Values ranged from 2.5 l./plant/week early in the crop to 15.5 l./plant/week when plants were mature and fruit set was heavy. The presence of disease was monitored visually on a weekly basis. Tomatoes were harvested July 9, 16, 23, 26, 30, August 3, 6, 10, 14, 20 and 29, 2012. Number and total weight of fruit were recorded at each harvest date.

Goals & Outcomes Achieved

The results of this study were published in the 2012 Bradford Research End of the Year Report and the September 2012 Tomato Festival where it reached over 400 people.
<http://aes.missouri.edu/bradford/events/2012-tomato-festival-flyer.pdf>

It was also shared with the Central Missouri Produce Growers School in November 2012 to over 200 attendees and will be featured in the Vegetable Growers Newsletter-Winter Edition 2013.

Table 1 clearly indicates that 'Health Kick' plants grafted onto 'Trooper' rootstocks out-performed non-grafted plants numerically in the three parameters used to measure yield: fruit number, total yield and average fruit weight. All data represents performance on a per-plant basis.

Table 1 Influence of grafting on fruit number, total yield and average fruit weight

Treatment	Fruit Number	Total Yield (kg.)	Ave. Fruit Wgt. (g.)
Non-grafted	62.7	6.2 (13.7 lb.)	99.3 (3.5 oz.)
Grafted	72.6	7.7 (17.0 lb.)	105.1 (3.7 oz.)

5.0*	0.70*	2.9*
------	-------	------

*Standard error mean

The same result of superior performance of grafted over non-grafted plants held true for early yield (Table 2). Early yield was defined as data collected on the first two harvest dates.

Table 2 Influence of grafting on fruit number, early yield and average early fruit weight

Treatment	Fruit Number*	Early Yield (kg.)*	Ave. Fruit Wgt. (g.)*
Non-grafted	57.8	1.6 (3.5 lb.)	99.4 (3.5 oz.)
Grafted	97.0	2.8 (6.2 lb.)	107.9 (3.8 oz.)
	19.6**	0.6**	4.3**

*First two harvests. ** Standard error

As stated earlier, the rootstock ‘Trooper’ carries resistance to tomato mosaic virus, *Fusarium* and *Verticillium* wilt, *Fusarium* crown and root rot, corky root rot, and nematodes. Indeed, an objective of this study was to determine if that resistance imparted any affect on the productivity of grafted plants. Weekly observations failed to identify any incidence of the above diseases, either on grafted or non-grafted plants. Therefore there was no data to collect or differences between treatments to analyze.

Beneficiaries

All current and future tomato producers should benefit from the results of this study. The fact that grafted tomato plants produced greater yield (both early and total) should enhance the profitability of the nearly 700 tomato production operations in Missouri. The use of grafted disease resistant rootstocks should benefit organic growers and has the potential of reducing or eliminating the use of fungicides for non-organic growers. High-lycopene tomatoes have the potential of commanding higher prices at the market and greater return to the grower because of their phyto-nutrient content. Also, consumers would enjoy the nutritional and other health benefits of high quality, locally produced, high-lycopene tomatoes

Lessons Learned

High tunnels provide a more ideal environment for tomato production compared with outdoor production. Highly amended soil along with warmer soil temperatures often prompt varieties growing on their own rootstocks to produce more vigorous root systems than when growing outdoors. This has caused some to question the need to bear the expense of grafting a more vigorous rootstock onto a hybrid scion. This study demonstrated that, even under more favorable conditions for root growth, grafted tomatoes out-yielded non-grafted. The latter fact should cause all growers to consider seriously tomato grafting as a standard, “best management practice”.

This study also was designed to determine the influence of tomato grafting on disease severity. The fact that there appeared to be little if any selection pressure for the common tomato diseases made any assumptions concerning the benefit of grafting on disease incidence impossible to make.

Contact Person

Dr. David Trinklein, Associate Professor Plant Sciences
573-882-9631
trinkleind@missouri.edu

Additional Information

http://agebb.missouri.edu/news/queries/showall.idc?story_num=6139
<http://ipm.missouri.edu/MEG/2012/8/Hot-Weather-Tomato-Problems/>
<http://ipm.missouri.edu/MEG/2011/4/2011-Year-of-the-Tomato/>
<http://ipm.missouri.edu/archive/meg/2011/v17n4.pdf>
<http://ipm.missouri.edu/archive/meg/2012/v18n8.pdf>
<http://leamingtongrower.com/2013/03/high-tunnels-increase-freshness-and-cash-to-producers/>

APPENDIX

Soil Test Report

University

Extension

University
of Missouri

-----MU Laboratories-----

23 P.O. Box 160
Columbi or Portageville, MO
(573) (573) 379-5431

Serial No. G87813H-2	County Boone	Region 3
Submitted 3/26/2012		Processed 3/28/2012

<http://www.soiltest.bsu.missouri.ed>

Sample ID: HOOP-WEST

This report is for:

Lab No: C1210600
DAVE TRINKLEIN
1-87 AG BLDG
COLUMBIA MO 65211
trinkleind@missouri.edu

Last Limed: unknown

Submitted by:
Firm No. 80 Outlet: 998
soiltestingservices@missouri.
edu
573-882-0623

SOIL TESTING LAB-RESEARCH
23 MUMFORD HALL
UNIVERSITY OF MISSOURI
COLUMBIA, MO 65211

SOIL TEST RESULTS		RATING					
		Very low	Low	Medium	High	Very high	Excess
pHs	7.7	*****					
Phosphor us (P)	550	*****					
Potassium (K)	368	*****					
Calcium (Ca)	5621	*****					
Magnesi um (Mg)	1052	*****					
Organic Matter:	5.7 %	Neutr. Acidity: 0.0 meq				CEC: 18.9 meq	

Fertilizer & Limestone Recommendations (lbs/1000 sq ft)

Crop	Nitrogen (N):	Phosphorus (P ₂ O ₅)	Potash (K ₂ O)	Zinc(Zn)	Sulfur (S)	LIME
1 vegetables	0.0	0.0	0.0		22.0	0 0 0